Welding Engineer

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JANUARY, 1956

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PRODUCTION WELDING
Oil Resistant Jacket
(Built Like Tire Tread)
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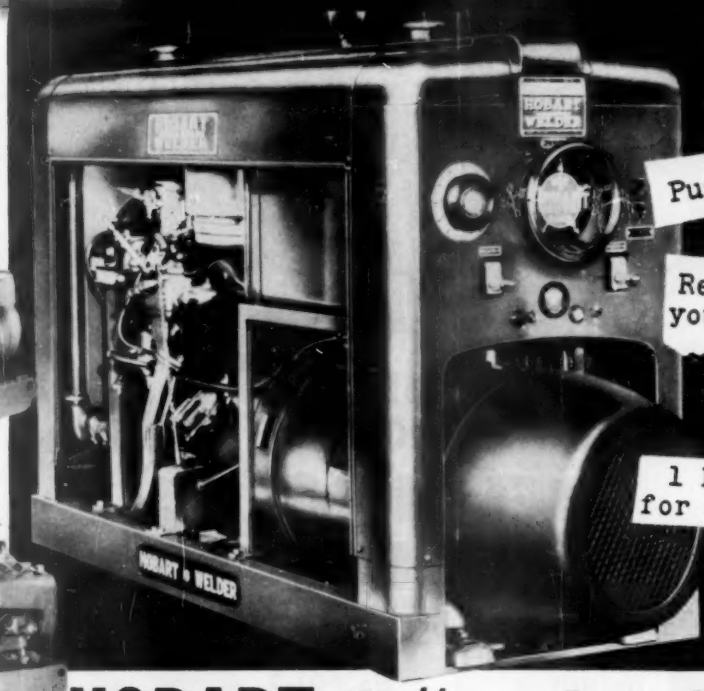
SHIPYARD WELDING
Can't-Slip
BELDEN NON-SLIP JACKET
DOES NOT SHRINK FROM ELECTRODE HOLDER
REPAIR SHOP
BRIDGE WELDING
FIELD CONSTRUCTION
Long Flex Life
No individual copper strand is ever under tension Withstands over 50,000 flexes
WELDING CABLE
by Belden
WIREMAKER FOR INDUSTRY SINCE 1902
1-18



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WELDS ANYWHERE

Ready to go to work for you on a moment's notice

Dual Control

1 kw DC Auxiliary Power for running Tools & Lights

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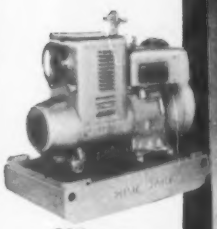
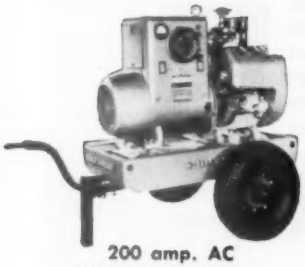


200 amp. "Husky Boy" air cooled

250 amp. "Big Brother" air cooled

HOBART 250 amp. "contractors special"



200 amp. AC Welder—AC Power

300 400 600 amp. Portable Gas Drive

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Hobart offers A COMPLETE LINE of welders with "extra" and added built-in features to do specific jobs.

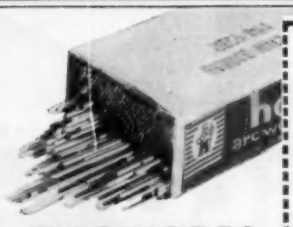
Bigger savings and added profits show up on jobs when you have the welder best suited to your own particular type of work.

Make a comparison—you'll quickly see why a Hobart welder is outstanding. Check the coupon for specification sheets that point out Hobart advantages and the reason for its being the choice of leading metal working industries everywhere.

HOBART BROTHERS CO., Box U-16, Troy, O., Phone 21223

HOBART TROY OHIO WELDERS

CLIP THIS COUPON and MAIL TODAY



Hobart electrodes are time tested and approved to give top performance, maximum efficiency and quality welding for a wide variety of welding applications. Electrodes for mild steel that are usable in all positions with AC or DC, straight or reverse polarity.

NEW arc welding ELECTRODES

Popular among operators everywhere, because they are easy to use—easy to strike and hold an arc. If you haven't tried Hobart's new No. 10 and No. 12, you'll be surprised at the real difference in welding electrodes.

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☐ AC Welder-AC Power ☐ Portable Gas Drive

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FIRM _____

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DURABLE, LEAK-PROOF WELDING HELMETS

No. 401-2 with Lift-Front Lens Holder

• This is a seamless fiber helmet which permits easy layout and inspection of work. It features the #2 streamlined lift-front lens holder with shock-absorbing action. It has every safety and comfort feature. The helmet has an adjustable chin rest and form-fitting adjustable headgear with leather sweatband.

No. 401-7 with Stationary Lens Holder

• Here is an extremely popular all-purpose helmet which meets the safety and comfort requirements of most production and maintenance welding. It is equipped with a #7 leak-proof, telescoping lens holder. Comfort is provided by an adjustable chin rest, form-fitting headgear and a leather sweatband.

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CESCO makes a wide variety of welding helmets to meet every requirement. These include Fiber Glass Helmets, combination Hat-n-Shield and Air-Fed Helmets. These quality products are backed by years of field experience.

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Welding Engineer

JANUARY, 1956
VOL. 41—No. 1

A MAGAZINE OF JOINING AND SEVERING OF METALS

America's pioneer publication which, combined with The Acetylene Journal, has been devoted to the interest of the welding and allied industries since 1898

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THE COVER commemorates our 40th—or ruby—anniversary.

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NEW All Nylon Adjust-O-Lok Headgear

Nylon, lightweight and non-conductive, lends its superior, long wearing strength to every part of this completely redesigned arc welding helmet headgear.

The large, easy to handle winged knob and the gear, both of Nylon, engage a Nylon headband to give fine adjustment to head size while helmet is worn. Headband is molded in one piece with a cross strap, *now also adjustable*, over the top of the head.

The headband adjustment is entirely enclosed in a Geon sleeve, smooth fitting against the head.

Jackson Leads Way with Better Helmets

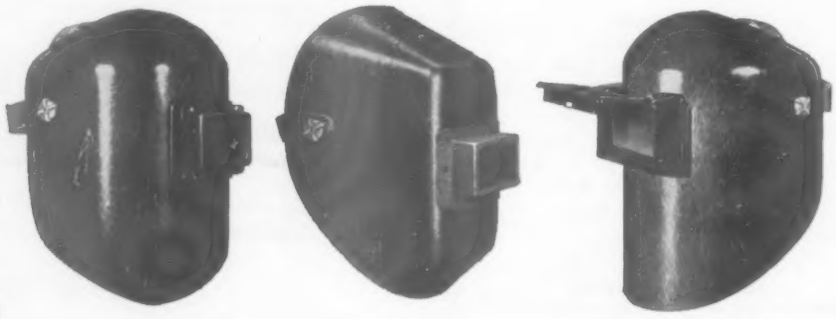
NEW Nylon Friction Pivots

All pivot parts are Nylon, except the entirely enclosed spring, so no current can pass through to the wearer's head. New winged nuts provide easier hand adjustment from the outside without taking the helmet off. A stop, located inside of the helmet shell, is attached to one of the Nylon pivots to halt the helmet's down movement, and is quickly adjusted to the exact position you may require.

NEW Straight Front Helmets with Fiber Glass Shells

To those who prefer helmets of this popular shape, JACKSON now offers a line of helmets of the same quality as its curved and narrow shell styles, with the same new features. Made of fiber glass, strong, smooth, easy to clean, resistant to heat and moisture, *they last.*

For the Best in Arc Welding Helmets Jackson Offers You 3 x 3 x 2 = 18 Models to Choose from



YOUR CHOICE OF:

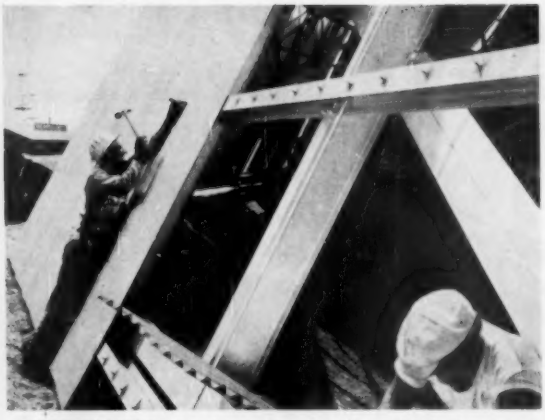
3 HELMET SHELLS...	CURVED SHELL	NARROW SHELL	STRAIGHT SHELL
3 LENS HOLDERS...	PLASTIC FIXED FRONT	METAL FIXED FRONT	PLASTIC LIFT FRONT
2 HEADGEARS...	THE NEW ALL-NYLON ADJUST-O-LOK — OR THE ECONOMY HEADGEAR No. 62		

All Lens Holders and Headgears are Interchangeable

Made by the World's Largest Manufacturer of Arc Welding Electrode Holders, Ground Clamps and Cable Fittings, Sold World-Wide through Distributors and Dealers.

JACKSON
PRODUCTS, INC.
WARREN • MICHIGAN

STEEL tanks for $130,000,000 Flying-A-refinery, near Wilmington, Del., almost fill Bethlehem Steel Co.'s weldment shop at Bethlehem, Pa. Plant will include three of largest oil processing units ever built. Weldor is shown at work on tank, lower right.



CORRUGATED aluminum sheeting for spherical storage warehouse was secured by stud welding. After sheeting had been impaled over the studs with rubber hammers, the studs were upset. (See story below.)

News

Program announced for Midwest Welding Conference

The complete program has been announced for the Midwest Welding Conference to be held Feb. 1 and 2 at Armour Research Foundation of Illinois Institute of Technology, Chicago.

Special emphasis is being given to resistance welding and design for welding because of interest shown in these topics last year.

Subjects to be covered Wednesday, Feb. 1, will be: "Powdered iron electrodes," Donald B. Howard, American Car & Foundry Div., ACF Industries; "CO_2 shielded inert gas welding," Richard W. Raney, A. O. Smith Corp.; "Non-destructive testing of weldments," Roger W. Clark, General Electric Co. "Fundamentals of resistance welding," William Farrell, Sciaky Bros.; "Resistance welding applications in aircraft fabrication," Earl B. Morris, Grumman Aircraft Engineering Corp.; "Applications of welding to rocketry," Francis H. Stevenson, Aerojet-General Corp.

John J. Chyle, director of welding research, A. O. Smith Corp., will be chairman of the morning session. Chairman for the afternoon will be Carl H. Samans, associate director, engineering research, Standard Oil Co. (Indiana)

Topics to be covered Thursday Feb. 2, will be: "Design for welded plate fabrication," Fred L. Plummer, Hammond Iron Works; "Design for structural welding," LaMotte Grover, Air Reduction Sales Co.; "Welding of heavy machinery parts," Norman L. Mochel, Westinghouse Electric Corp.; "Welding austenitic stainless steel for high temperature service," Roy W. Emerson, Pittsburgh Piping & Equipment Co.; "Joining of heat resistant alloys," Harold E. Schultz, General Electric Co.; "Welding problems in nuclear reactors," Robert A. Noland, Argonne National Laboratory.

Chairman of the morning session will be T. B. Jefferson, editor and publisher of WELDING ENGINEER; afternoon chairman will be Warren McGonnagle, associate physicist, Argonne National Laboratory.

* * *

H. K. Porter acquires Carlson & Sullivan, Inc.

H. K. Porter Co., Inc., Pittsburgh, recently purchased Carlson & Sullivan, Inc., Monrovia, Calif. The new subsidiary will become a part of the Henry Disston Division. It will be known as Carlson Rules and Measures, Henry Disston Division. Carlson & Sullivan, founded after World War II, manufactures steel tapes and rules.

Warehouse sheathed by stud welding

A dome-shaped storage warehouse recently built for Kaiser Gypsum Co., Long Beach Calif., was sheathed by stud welding. The warehouse, which employs no interior bracing, has corrugated aluminum sheeting secured by end-welded, composite aluminum studs.

Stud welding was chosen for its speed and because it would require no interior scaffolding. Operators with portable stud-welding guns simply climbed over steel framework to which studs were welded.

The job required 12,000 studs. Two welding guns were used, operating off a single-battery power unit. Templates established stud locations. The aluminum sheeting was impaled over the studs with rubber hammers and the ends of the studs were then upset.

Since portions of the studs that come in contact with the sheeting are aluminum, there will be no electrolytic action between the sheeting and the steel building framework. Appearance of the building is enhanced because the studs are almost invisible.

—Courtesy Nelson Stud Welding

* * *

Thor acquires rubber company

Thor Power Tool Co., Aurora, Ill., recently announced the acquisition of Cincinnati Rubber Mfg. Co., Cincinnati. The new subsidiary will operate with the same personnel, facilities and policies and will be known as the Cincinnati Rubber Division of Thor.

News . . . . . *from page 5*

TANK section, here being submerged-arc welded, will form part of compressed air storage tank for wind tunnel. (See story below.)

MEMBERS of welding distributors association for the New York metropolitan area are here shown at a regular monthly meeting. (See story below.)

Welded tanks give tunnel new wind

Welded spherical tanks will provide compressed air storage facilities for a supersonic wind tunnel. They are being constructed in Los Angeles for North American Aviation Co. by Pittsburgh-Des Moines Steel Co.

Each all-welded tank will hold 291,000 gal of air, compressed to 132 psi, which will permit testing to speeds three times that of sound.

Dished tops and bottoms of the tanks were site welded with the automatic submerged arc process. Assemblies were mounted on a large jig which rotated the seams under an automatic welding head. The head was carried on a self-propelled tractor which rode directly on the assembly. Tractor speed and rotation of assembly were synchronized. Welding speed was 8/10 ft per minute. Plate size was 1 3/16 in.

—Courtesy The Lincoln Electric Co.

* * *

Square D, Electric Controller to merge

Square D Co., Detroit, and Electric Controller & Mfg. Co., Cleveland, have called special meetings of shareholders to vote on merging the two firms. As this issue went to press, it was reported directors of both firms had approved the merger.

Combining operations, which requires approval of two-thirds of shareholders of both companies, would make the surviving corporation one of the largest manufacturers of electric-motor controls in the United States.

Upon approval of the merger, F. W. Magin, president of Square D, would become chairman of the board of directors. A. G. Patterson, president of Electric Controller, would become president of Square D.

* * *

Welders Needs, Inc. in new building

Welders Needs, Inc., Toledo, Ohio, distributor, has moved into its new building. The structure, which combines office and warehouse, is located at 3839 Doyle St., in that city.

* * *

New iron-powder and L-H electrodes for overlay

Two electrode manufacturers have introduced iron-powder electrodes designed especially for build-up and hardfacing applications.

These latest innovations on the already popular type of welding electrode have been made by The McKay Co., Pittsburgh, and The Lincoln Electric Co., Cleveland, whose announcements were made almost simultaneously.

The McKay firm's product is an iron-powder, low-hydrogen type intended for hardfacing. Lincoln's new electrode is primarily designed for fast build-up of worn parts prior to depositing a finish pass of hardfacing material. For more detailed information about both electrodes, read the new products section of this issue.

New York suppliers help each other

In the two years since its founding, the New York area Welding Supply Distributors Association, Inc., has proved itself a real boon to its members. There are now 29 members composed of metropolitan New York City and Westchester county distributors.

Recognizing the need for reliable credit information and help in locating lost or strayed fuel cylinders, the organization was formed by a group of distributors in June, 1954. Benefits have been increased cooperation among members in returning cylinders; establishment of a credit bureau; and promotion of better distributor relations.

Officers of the organization are Frederick Zimmer, president, Zimmer Welding Supplies & Service, Inc.; Roland H. Maser, secretary, Maser Welding Supply; David Bregman, treasurer, Elk Welding Supply Co.

Organization headquarters are in Elmhurst, N. Y. Meetings are held monthly.

* * *

Welding institute to be at Madison

A three-day welding applications institute will be held Feb. 22, 23 and 24 at the University of Wisconsin, Madison. The sessions will cover the following:

Application of contact electrodes; mild steel, low hydrogen and low alloy arc welding electrodes; use of

(Continued on page 111)

2 safety valves . . .

quickly adjustable but entirely tamper proof

Only an Allen wrench of proper size will adjust the pressure setting of these "*self-reseating*" relief valves. They are tamper proof and cannot be made inoperative by unauthorized and inexperienced individuals.

safety — that's their only business

and, to be safe they must have the ability to stay safe . . .

These two, self-reseating, safety valves fully protect both the first and second reduction stage of this regulator. The relief valves, both of identical design and construction and with interchangeable parts, are factory set to work at pressures slightly beyond proper working pressure maximum. Your repair man can reset them easily and absolutely reliably—however, outsiders may not do so; that is important to you.

a safety valve which can be tampered with is very dangerous indeed . . .

National of . . . california

a 40-page book — free of charge — offers you a wealth of regulator data; why not write for it TODAY.

NATIONAL welding equipment company . . . 218 fremont street san francisco 5 california

523

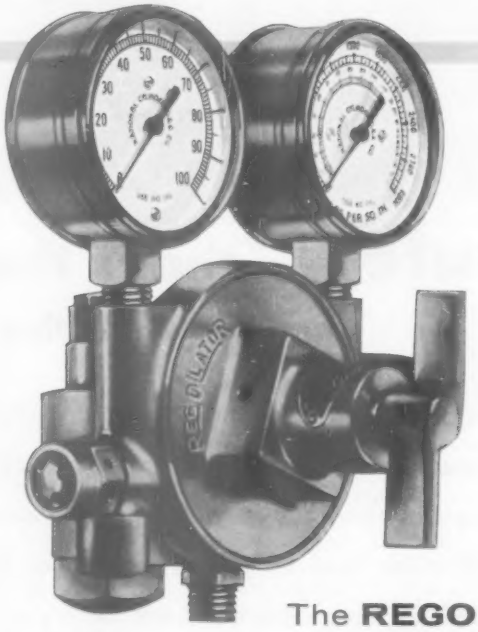
REGO*

Better Tools for Better Welding and Cutting

When you have Rego regulators, torches and tips, you get welding and cutting that excel in pace of production, in quality of welds and cuts, in freedom from the uncertainties and interruptions that so frequently hamper the operator's efforts. The human element, the fatigue factor, are minimized. *Every* operator becomes a *better* operator.

These better tools for better performance are built to last. Forty years of experience, of pioneering, of constant progress in design and manufacture stand behind Rego products and guarantee your complete satisfaction. See them at your earliest convenience, the sooner to start cashing in on increased production and economy. Try them in comparison with any others.

Your nearest NCG dealer or branch office will be glad to arrange a demonstration. Or write today for descriptive literature.



The **REGO**

Two - Stage Regulator

for stable, unvarying gas pressures

Two-stage construction. Balanced design using opposing valve characteristics maintains preset gas pressures unvaryingly through all stages of usable pressure. No more varying flames; no more running back and forth to make corrective adjustments. You set it and forget it.

Cartridge type sintered metal filter serves double purpose: keeps out destructive dust and dirt, lasts longer; prevents seat ignition by radiating recompression heat to valve body. Diaphragm mounting and bonnet have safety vents. Automatic relief valve protects from excessive pressure in first stage cavity. Forged bronze construction assures long life.

Models for standard duty, heavy duty and manifold service. Also single stage regulators.

NCG®

EVERYTHING FOR WELDING

NATIONAL CYLINDER GAS COMPANY

840 NORTH MICHIGAN AVENUE, CHICAGO 11, ILLINOIS

Branches and Dealers from Coast to Coast

*Registered trademark of The Bastian-Blessing Co.

REGO GX Welding Torch

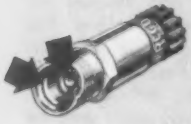
for ALL welding . . . from lightest sheet to heaviest casting

Superior design and painstaking manufacture account for the superlative performance and long life of the Rego GX. Precision adjustments, easily made, unvaryingly held, provide maximum flame efficiency. Free-flow mixer has proportioned and machined gas passages for perfect mixtures. Unique mixer design brings acetylene in through center, snuffs out fire in event of backfire or flashback. Mirror-burnished tip passages eliminate turbulence.

Fatigue factor minimized by tremendous weight-reduction. Handle and body made of lightweight yet strong aluminum alloy. So light and so perfectly balanced operators everywhere prefer the GX torch for this reason alone.

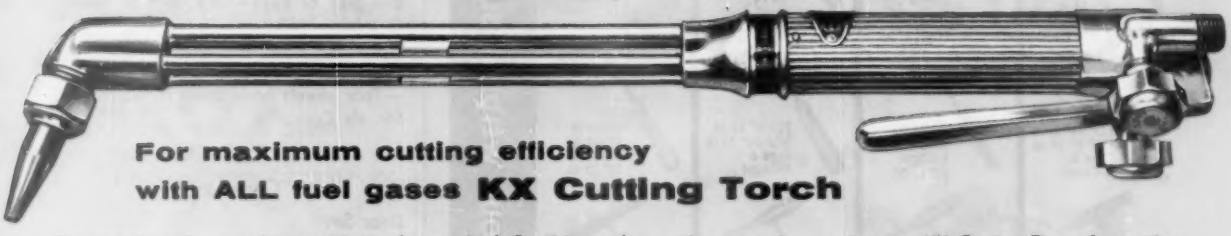
GX handles lightest sheet up to heavy castings. Operates at low pressures producing soft flames. Cylinder residuals reduced to a minimum. With KXA Cutting Attachment will cut steel up to 8" thick.

Leak-proof Joints . . . with Hand Tightening



Neoprene seating rings in the torch head permit positive, leak-proof coupling of mixer and handle with hand tightening alone. Result is longer torch life. No metal-to-metal contact. No strain on threads. Seating rings absorb normal wear and abuse, prevent scratching or scoring of metal seating surfaces.

Big, easy-grip valve wheels permit precision setting. Chrome-plated valve seats, monel valve stems. Non-seizing, non-scoring.



For maximum cutting efficiency with ALL fuel gases KX Cutting Torch

For toughest heavy-duty cutting of plate, multiple plate, slabs, sheets, and scrap. Ideal for use in shops, industrial plants, scrap yards, railroads—*wherever maximum cutting capacity is required.* Precision valve settings remain stable and uniform. Mixer delivers perfectly mixed gases. Perfectly proportioned and swaged tip passages provide non-turbulent preheat flames. Tip-mix type KX Cutting Tips—for cutting lightest sheet metal to heaviest sections—are available for use with any fuel gas.

Diaphragm type high pressure valve in forged brass body replaces conventional packing to prevent leaks. Long high pressure lever gives operator precise control of cutting oxygen.

Stainless steel tubes in triangular construction give maximum strength and rigidity. Tubes silver-brazed at head and valve body to provide strong leakproof joints.

Stainless steel head withstands high heat without distorting, eliminates gas leaks that result from warped seating surfaces.

NCG 44 Bantam® Welding Torch

for LIGHT welding

The one light welding torch with all the features welders look for. Welds aluminum and alloys, aircraft tubing and steel from 28 gauge to 3/8" thick. It's light, easy handling, compact—*gets into an absolute minimum of space.* Valve wheels are right under your thumb for quick adjustment. Stainless steel stems are non-seizing and non-scoring. Nickel alloy tubes are silver brazed for added strength. Uses swaged-style Series NCG-71 Tips or screw-in style Series NCG-170 Tips. Length, less tip—6½".

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You Can't Beat ATLAS Quality

The modern Atlas plant is devoted exclusively to building the finest weld cleaning tools in America. There are models to suit the man and every type work. If you haven't tried Atlas you don't know what a difference "balance and feel" can make in production and quality of work. They can take it.

ATLAS WELDING ACCESSORIES CO.

707 E. LEWISTON AVENUE, FERNDALE 20 (DETROIT) MICH.

ATLAS LINE

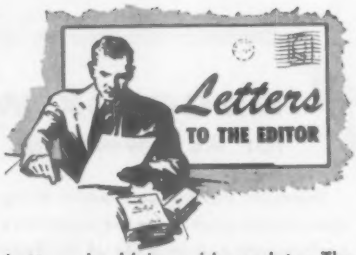
B-1 "Re-Bit" Dual Tool 10½" 16 oz.
B1-W "Re-Bit" Dual Tool 10½" 15 oz.
Model A Dual Tool 10½" 17 oz.
Model AW Dual Tool 10½" 16 oz.
Model E-1 "Re-Bit" 9" 12 oz.
Model E1-W "Re-Bit" 9" 10 oz.
Model F-1 "Re-Bit" 10" 16 oz.
Model F1W "Re-Bit" 10" 14 oz.
Model G Chisel & X-Chisel 9" 14 oz.
H-9" 14 oz. L-10" 17 oz. Cone & Chisel
Model I Chisel & X-Chisel 9" 13 oz.
J-9" 13 oz. N-10" 15 oz. Cone & Chisel
LCP-10" 17 oz. HCP-9" 14 oz. Cone & X-Chisel
Model K Cone & X-Chisel 10" 17 oz.
JCP-9" 13 oz. NCP-10" 15 oz. Cone & X-Chisel
Model M Chisel & X-Chisel 10" 15 oz.
Models WH: 10-20-30 12" 14 oz.
Model C "Re-Bit" Chisel & symbol
Model CW "Re-Bit" Chisel & symbol
Models OCC—OCP—ODC 9½" 10 oz.

ASK YOUR WELDING SUPPLY DEALER TO SHOW YOU THE

A good weld cleaning job performed with good professional tools will better reveal the quality of the weld

ASK YOUR WELDING SUPPLY DEALER

You Can't Beat ATLAS Quality



Letters should be addressed to: The Editor, WELDING ENGINEER, 12 E. Grand Ave., Chicago 11, Ill. No letter will be published unless signed, but your name will be withheld if requested.

Safe welding

Dear Sir:

I am in the process of preparing a paper on accidents and illnesses encountered in welding operations. The paper will include a discussion of security rules. It will be presented at a reunion of engineers and technicians.

I wonder whether you might send me a tear sheet of the following articles: "Safe ways to weld gasoline tanks," October, 1954; "Stop oxyacetylene fires," January, 1954; "You have only one pair of eyes—take care of them," October, 1953.

V. Machado de Carvalho
Lisbon, Portugal

—Tear sheets have been forwarded to Mr. de Carvalho.

* * *

Overlays

Dear Sir:

Would you please send us a tear sheet of "Overlays that halt surface wear" by F. E. Garriott, which appeared in the October issue of WELDING ENGINEER?

J. E. Hawking
Pines Engineering Co., Inc.

—Tear sheet of the article has been forwarded to Mr. Hawking.

* * *

Welding with CO_2

Dear Sir:

I wonder if you could help me in respect to the inert process using CO_2 as a shielding medium. An article on the subject "Tig welding with a CO_2 shield" appeared on page 28 of your June, 1955, issue.

My main trouble—not having consistent results—seems to lie in not knowing what percentage of dryness is necessary to estimate the erratic behavior of the weld deposit. Also, I would like to know whether companies doing research are using admixtures of other gases and what percentage, if any.

I am a faithful follower of WELDING ENGINEER and proud possessor of

every edition of *The Welding Encyclopedia.*

If this is not convenient, I should appreciate receiving addresses of the companies working on CO_2.

James Fairbairn
London, England

—A copy of Mr. Fairbairn's letter has been sent to several firms concerned with manufacture of Tig and Mig welding equipment using CO_2 as a shielding medium.

* * *

Coal bucket welds

Dear Sir:

In your November issue there is an article entitled "Coal bucket welds," by Walter E. Palmer.

I could take issue with several things therein . . . but what I really take issue with is the statement that E7016 electrodes are used to repair cracks in manganese and for attaching manganese wear plates to buckets. It is a metallurgical fact that when mild-steel electrodes are used to weld Hadfield manganese (12-14% manganese), somewhere in the weld there is an extreme brittle zone which will crack.

Either manganese electrodes or stainless steel should be used to weld manganese to carbon steel plate. Once in a great while, someone gets away with murder and apparently makes a successful weld, but in the long run we had better stick to the proven practices.

Fred Judelsohn
J. A. Cunningham Equipment, Inc.

* * *

Pressure vessel test

Dear Sir:

After reading your monthly editorials —and I do get a lot of good from your articles—I figured you might be able to help me solve a problem.

I am a weldor, both acetylene and electric. I have 17 years of experience in the field. Recently, I gave up my job where I had been the first line weldor.

I thought the editorial "Too much regulation" in October was very true, indeed. Problems in engineering and design phases of welding are definitely left up to the weldors to solve. They are also supposed to teach or tell the other men the how and why and procedures of fabricating jobs. Shop foreman and supervisors go around as if they had feathers in their caps.

In my opinion, welding in such shops as these is just another production center. Supervision doesn't know what procedures to use in a lot of cases. Just get the job done and get it shipped out fast—this is the view.

The main part of this letter is this: I am interested in taking the test for re-

(Continued on page 58)

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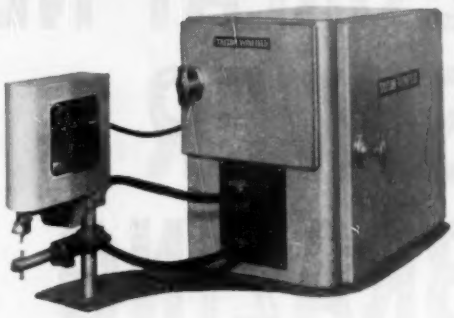

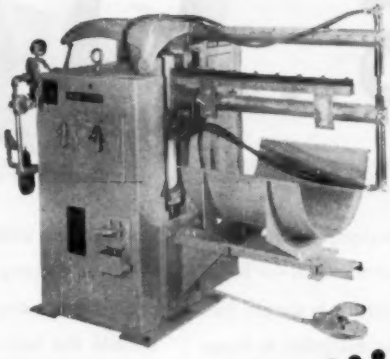

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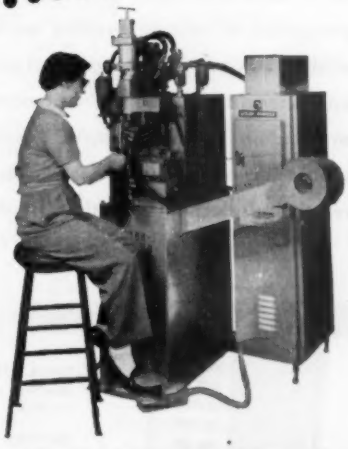

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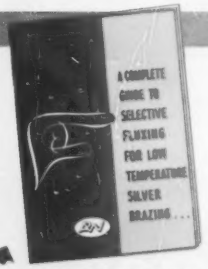

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JANUARY, 1956

Welding Engineer

ESTABLISHED 1916

Our Ruby Anniversary

FORTY YEARS is not very long in terms of recorded history on our planet, but it covers a major span in the history of welding.

When the late L. B. Mackenzie conceived the idea in 1916 of publishing a magazine for those engaged in joining and severing metals, there was little interest in these new processes. Most people of that era looked upon welding as a maintenance process of dubious value.

Mr. Mackenzie, however, had tremendous faith in welding. As a railroad employee in 1911, he had seen the first major example of production welding—a spot-welded gondola car.

To him welding was the only completely new method of joining metals (if we except forge welding in the blacksmith shop) developed in several thousand years. It was a method that made it possible to join metals as they should be joined—homogeneously rather than pinned or pegged (with bolts and rivets), as wood is joined. Mr. Mackenzie felt that the only thing wrong with this new joining method was that too few people knew about it.

He saw that the process would grow only if the world had a free exchange of welding and cutting knowledge. He exhibited his convictions by launching WELDING ENGINEER in January, 1916.

WITH this issue of WELDING ENGINEER, dated January, 1956, we celebrate our 40th birthday. Few publications can boast of a longer period of service to the metalworking industry, and none has served the welding industry for such a length of time.

We have often heard that "life begins at 40." That could certainly be true of WELDING ENGINEER, with its future growth geared to the future of welding. Never has there been so much welding in so many places as there is now at the beginning of 1956.

Elsewhere in this issue, considerable space has been devoted to what has taken place in welding in the past 40 years as well as to what the next 40 years may hold. For this reason we will try to refrain from repeating those thoughts here. There are milestones, however, which should be mentioned, events which are a part of welding history.

While some of these occurred before WELDING ENGINEER was founded, none of the important advances (other than basic discoveries) preceded the initial 1898 publication of the ACETYLENE JOURNAL, which was later absorbed by WELDING ENGINEER. Thus, the major highlights are included in the span covered by WELDING ENGINEER.

THE Wilson Award of 1918 did more to confuse welding than any other single event in the past 40 years. Secretary of Labor William Wilson, in settling a labor dispute on the railroads, ruled that welding was a tool rather than a trade. This particular ruling has always been a stumbling block in attempts to organize a craft union.

In 1919, we saw the first completely welded ship—a job that was accomplished with bare-wire electrodes, but proved the practicability of welding in shipbuilding as well as the use of a-c welding equipment.

That year was a big one for welding. The Welding Committee of the World War I Emergency Fleet Corp. reorganized itself into the American Welding Society, and WELDING ENGINEER became the official voice of that group. This pleasant relationship was carried on for four years when the society established its own publication.

Welded pipelines came into existence in 1921. The first lines were experimental. For many years following, most of them were oxyacetylene welded. There was quite an evolution in joint design on pipelines, the first joints being of a sleeve-type, then a bell and spigot. Finally, in the late '20's, it was decided that piping could be butt welded.

At the same time these tests were being conducted, a couple of weldors in a West Coast oil field were experimenting with the use of welded overlays to prolong the life of drilling

Editorial . . .

bits. Before long these experiments became practical applications, and the *hardfacing* industry was launched.

In 1924, L. B. Mackenzie died prematurely of pneumonia. Welding had not yet contributed to the research that has practically eliminated fatalities among victims of that disease. It was several years later that welding was used to build pressure vessels which eventually made it possible to produce wonder drugs at a cost that makes them available to everyone.

Just before the stock market crashed in 1929, the ACETYLENE JOURNAL, a 31-year-old publication devoted to promoting uses of acetylene and oxyacetylene welding, was acquired by WELDING ENGINEER.

The oxygen and acetylene industry, however, soon went through a series of mergers wherein most of the independent producers were absorbed by one of the four major companies which today dominate the field. This building of giants in the industrial gas field eliminated the need for the ACETYLENE JOURNAL, and its activities and editorial policies were combined with WELDING ENGINEER's.

Just after Franklin D. Roosevelt went into office, WELDING ENGINEER reached its all-time low, and had to battle for survival. But the crisis soon passed, and America's pioneer welding publication began its climb in successful business-paper journalism.

WELDING ENGINEER began growing and carrying to its readers the creative engineering imagination that had allowed welding to invade more and more industrial fields. Working men the world over learned from the pages of WELDING ENGINEER how new processes could be used in joining and severing metals.

IN AN attempt to make the United States the "Queen of the Seas," the maritime commission began a shipbuilding campaign in 1936 that eventually led to the construction of some 5,000 *welded* ships during the next 15 years. Very few persons heard about the 5,000, yet almost everybody is aware of the 15 that *failed*.

With the approach of World War II, many important industrial developments were made in welding. In 1939, spot welding of aluminum for aircraft began. Plastic welding came into widespread use after several years of experimental work. The demand for better, lighter and stronger armaments led to extensive welding applications in many fields.

These expanded applications have now made all industry dependent upon those processes that have made the joining and severing of metals so easy. Some people are inclined to doubt that *all* industry is dependent upon welding, but name any specific industry you choose—it uses machines, and machines are made of metal.

These metal parts are joined by welding. Worn surfaces of metal are built up by new and harder surfaces deposited by welding, or by the closely related metallizing process. Even widely dissimilar metals can be welded.

Always interested in promoting the best in welding journalism, we introduced a new word to the American vocabulary. Using the term *weldor* when referring to a welding operator made it easy to distinguish the man from the machine. Like so many pioneering efforts, acceptance was an up-hill struggle. Finally, when *weldor* became a word in the dictionary, its use became more widespread, until today it appears in many advertisements.

Towards the end of World War II, in November, 1944, WELDING ENGINEER carried an editorial entitled, "Shall We Stand Alone?" Many of our editorials have excited interest but none quite so violently as "Shall We Stand Alone?"

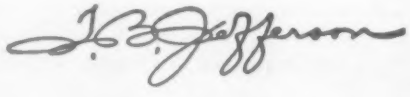
FOR a short while it looked like the *editor* would be standing alone out in the cold as a result of this editorial advocating a separate welding show—for several advertisers (after having seen a preview) went so far as to say "if that editorial runs, we won't advertise any longer."

Fortunately, these threats were never carried out, and eventually the welding industry *did* stand alone. And after three successful welding shows, everyone is happy about the decision.

Always a leader in editorial opinion, WELDING ENGINEER has done its best to promote modern means of joining and severing materials. While not everyone agrees with our opinions, there are few who would deny that WELDING ENGINEER has the concern of the field it serves at heart.

Yes, welding has come a long way in 40 years. We are happy to have had the opportunity of playing a small role in spreading the word about welding. We are grateful to those who have helped us in this task—particularly the seven manufacturers whose ads have appeared in WELDING ENGINEER regularly since its inception.

We hope to be around for another 40 years and then some.



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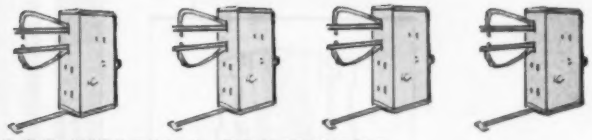

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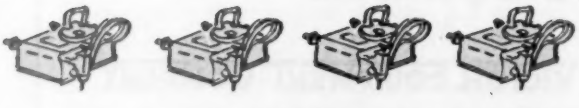

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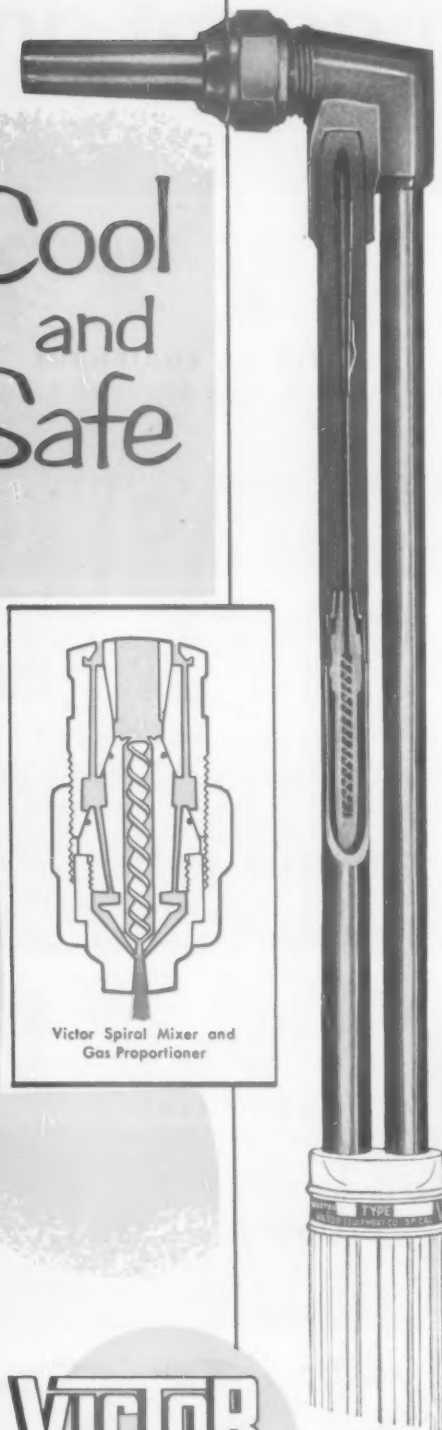

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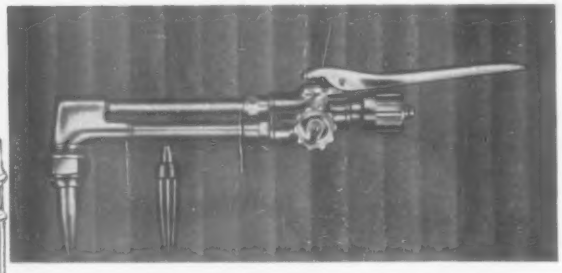

Cutting attachment, and cut-away of a typical Victor tip, showing carefully proportioned orifices. For best results, always use Victor tips with Victor torches.

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THE OLD (left) is represented by this 1919 model a-c welder. The application is a carbon-arc weld with a flux-coated filler rod.

THE NEW (right) is this vastly different a-c welding unit which was manufactured 30 years later.

—Photos courtesy Electric Arc, Inc.

Milestones of an industry

40 years with welding

BY T. B. JEFFERSON
and
F. T. TANCULA

WE BELIEVE that even L. B. Mackenzie, founder of WELDING ENGINEER, would be surprised to see the strides made by the welding industry in the past 40 years.

The four decades that have elapsed since the first issue of this magazine was printed in Chicago have been marked with a steady, sometimes explosive, progress. But the future looks even brighter, for this is only the beginning of the "golden age of welding."

Welding, of course, is more than 40 years old. Primitive means of welding were used in the early stages of metal development. Even fusion welding as we know it today had its beginnings in discoveries made more than 100 years ago. Priestly, Scheele, Davy and others anticipated future developments.

But the real start of fusion welding is usually credited to de Bernardos who invented the process of electric welding in 1885.

Resistance welding came three years later when Elihu Thomson's patent was granted. In 1900, Fouche and Picard developed the first commercial oxyacetylene torch, and the art of gas welding was on its way.

But these various welding processes were never put to extensive use until about 1906. Until then they lay dormant or were confined primarily to experimental work. Then, 50 years ago, early users of welding began to install equipment for commercial use.

The International Acetylene Association, founded before the turn of the century, envisioned new fields for acetylene back in 1909 . . . even automatic welding and cutting was mentioned! The IAA was optimistic because by that time calcium carbide and oxygen production were high enough to meet the demands of industry. (Oxyacetylene welding could not grow rapidly before because the gases were not produced in sufficiently large volumes.)

However, during the first 10 years that welding was used in this country, its advantages never received the attention of more than just a handful of persons in the metal-working industry. And they were already sold on it.

Voice of the Industry

How to spread the gospel? It was in 1916 that Mr. Mackenzie decided that welding should receive nationwide attention from the metal industry. So WELDING ENGINEER was founded.

But gas and arc welding as production tools never received widespread sanction until after World War I. When the United States entered that war, only resistance welding was used in production. Arc and gas welding were considered primarily as maintenance and repair tools.

But these tools helped win the war. They made it possible for this nation to repair enemy merchant ships that had been sabotaged in our ports and to return them to service in less than nine months' time. Welding greatly simplified the problem of repairing intricate castings, and our shipyards were able to put those "irreparably damaged" vessels to good use.

While welding was still relegated

to its maintenance role, flame-cutting began to assume importance as a production process. Besides freeing machine tools for other work, flame-cutting performed many jobs faster.

By the end of the war, however, arc and gas welding were gaining ground in production applications. Shipyards, noting the success of these methods in repair work, turned to them for initial construction work. By the beginning of 1919, many ships were of practically all-welded construction. Despite the fact that bare-wire electrodes were used, these arc-welded ships rendered many years of faithful service.

AWS Is Founded

Shortly after, the American Welding Society was founded. At the Armistice, the welding committee of the Emergency Fleet Corp. lost its official status. The decision of industry leaders to perpetuate it resulted in the founding of the AWS in March, 1919.

More modern methods of joining metals by welding came into existence after World War I, although the idea of using a shielding gas in the arc zone dates back to about 1890. The gas proposed for this purpose, believe it or not, was *carbon dioxide*, which in the past two years has been hailed as the "new" shielding medium.

Helium and argon were recognized as effective shields for welding arc zones in 1920. Hobart and Devers received basic patents for inert-gas shielded welding using a refractory electrode in 1930. First commercial application of this process is usually credited to Northrup Aircraft, which used it in 1940 to join assemblies fabricated from magnesium.

Although it was under consideration for many years, a practical method for feeding a reel-wound consumable electrode into an inert-gas zone was not introduced until 1948.

The Roaring Twenties

Back to the Roaring Twenties, whose advent brought many more advances in welding.

Welding was gaining status as a production tool in more and more industries. New outlets were being discovered for uses of arc, gas and resistance equipment.

The first extensive expansion of welded pipelines was begun early in the period, and welding is now the conventional means of joining such cross-country lines.

The automobile industry greatly expanded the use of resistance welding in the '20s and, in fact, the latter replaced other types of welding in the automotive field.

Coated Electrode Introduced

By the middle of that decade it was common practice in this country to gas weld tubing in airplane fuselages, although England and France still prohibited it. Gas welding received new impetus from the aircraft industry and added strength with the introduction of hardfacing in oil fields.

The coated electrode was another development of the '20s. Earlier it had been found that in many arc welding applications, better results were obtained with a bare-wire electrode that had been slightly rusted.

Experiments with coatings followed, but these moved rather slowly: e.g., Kjellberg was granted two patents (one in 1907, another in 1912) which described electrode materials, coatings and minerals for slag formation.

But solid electrodes with extruded coatings were not made until about 1925, and not for commercial use until 1929. (For a more detailed account, see "A short history of the coated electrode" in this issue.)

Encouraged by the success of coated mild-steel electrodes, the industry began experimenting with coatings for other types, such as stainless and aluminum, to see if satisfactory results might be obtained in joining these alloys by the arc process.

Metal-arc welding grew at a fast rate in the early '30s also. Design engineers and architects began to give more thought to its application in construction of buildings, bridges and other structures. It was in 1931 that codes for welded power boilers and unfired pressure vessels were adopted.

On the vehicular tunnel built between Detroit and Windsor, Canada, arc welding was used to caulk the circumferential seams of the shell.

An Important Role

By the middle '30s, welding had made possible a better standard of living.

Some welding contributions up to then:

It had made possible the tight one-piece construction of the modern refrigerator, washing machines and other household appliances.

Radio reception was improved immensely by the resistance welding of tube filaments.

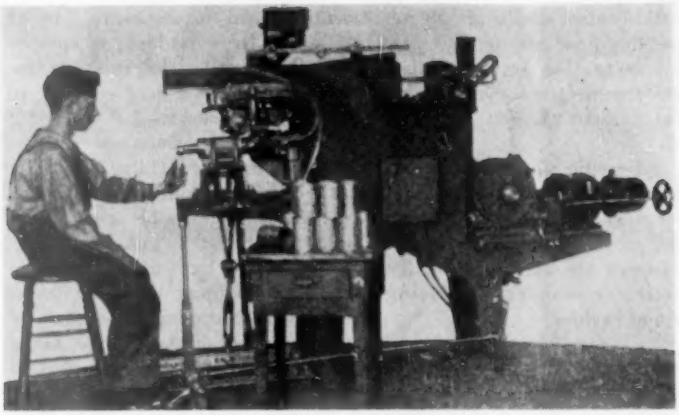
The automobile was stronger and lighter as a result of the increased use of welding.

The depression of the '30s naturally affected the welding industry, but it was quick to recover and continue its climb to greater heights.

The submerged-arc welding process has made great strides since it was first commercially used in 1934. It was developed in answer to the increased demand by structural fabricators and shipyards for a faster means of welding heavy plate.

Although today it is also used semiautomatically, the automatic submerged-arc method proved to be an

—Courtesy Fibre-Metal Products Co.



MOTOR-driven seam welder was new in 1916 when it was built by Toledo Electric Welder Co. of Cincinnati. Machine welded 12-in. seam in five seconds. Application here is on coffee pots.

OXYACETYLENE welding joined pipe sections near McDonald, Pa., in 1916 for what was then the deepest well in the U.S. —7,181 ft.

answer to the need for speed . . . it made possible the joining of thick plates at speeds never before envisioned.

More automatic welding and motor-driven cutting machines were also being developed in this period.

Then came Pearl Harbor and World War II!

Golden Opportunity

Its role greatly expanded since 1918, welding during World War II proved itself even more valuable. Ships for material and troop movements, tanks, planes, guns; everything made of metals, in fact, was welded.

Although introduced in the late '20s, very little coated-electrode welding was being done prior to the second world war. The all-out effort, however, stimulated research and a satisfactory coated electrode for use with a-c welding sources was attained.

Up until 1940, most arc welding was done with d-c (motor-generator) sets, often using bare-wire electrodes. Since World War II, a-c welding has dominated the scene, although the recent success of d-c rectifier power sources has shaken the throne of the a-c king.

Another wartime development was the low-hydrogen electrode for joining low-alloy steels. The addition of iron powder to electrode coatings has been still another step in the never-ending attempt to improve the welded product.

Although it is only presently gaining wide acceptance here, this contact-type electrode was introduced in Europe more than 10 years ago. The recent marriage of the low-hydrogen type to the iron-powder electrode has proved an even greater success.

More Uses for Tig and Mig

The Tig (tungsten inert-gas) and Mig (metal inert-gas) processes have proved most effective on thin-gage non-ferrous materials, although the latter is currently finding more applications in the joining of mild steel. Also, the use of carbon dioxide as a shielding medium for both these processes has already received a great deal of attention from the industry.

The contemporary history of welding alone would necessitate more lineage than we can give it here, but mention must be made of the many various processes that are akin to the basic three.

Atomic-hydrogen, stud and thermit welding have been found highly successful in more specialized applications.

In the resistance field, three-phase machines are now extensively used for welding aluminum aircraft assemblies where single-phase welders might present a power supply problem.

Some of the contemporary developments that are only beginning to make their mark upon the scene include automatic welding with a flux-cored wire in an inert-gas blanket or with magnetic flux-coated wire, induction welding and brazing, cold-pressure welding, electronic tracers for controlling flame-cutting machines, powder cutting, welding of plastics, adhesive bonding and the Tig process for cutting non-ferrous metals.

The more than 40 different welding and cutting processes have naturally made the industry one of specialists. Each method has been the subject of intensive research, and each has its devotees. Regardless of the joining problem, if it's metal or plastic, it can be welded.

But what about the future . . . the limitless future?

Automation in welding is more than a slogan. Even today, the tendency toward automated welding processes is evident. But the years are expected to bring into this sphere operations that today can only be performed in the best manner by the manual arc method.

Of course, resistance welding can lay claim to more automatic applications than any other process, and it will no doubt remain at the front of the race.

More new products will be assembled by welding as more metals are made available in welding grades.

In the immediate future, the construction field probably holds more promise for welding than any other. The industry has found recognition in production and maintenance. But the increasing use of welded steel buildings and houses indicates an acceptance, belated though it may be, from architects and builders.

Before we take a peek into the distant future, it might be well to quote the words of AWS President Joe Humberstone, who reminded delegates to the recent national fall meeting of that organization not to "overemphasize the new, for I submit that

BEFORE vulcanized fibre helmets swept the field, many weldors wore this aluminum mask with patented features which included inset filter glass plate.

the oxyacetylene flame will never grow old . . . the stick electrode will continue to be used."

And in the Future

Looking into the crystal ball, it is easier to see the results of future welding processes than to see the processes themselves.

Imagine this in 1995. Electronics and nuclear energy have become an important part of all welding processes in 1995. Automation has been developed beyond our fondest 1955 expectations because of the widespread use of "cybernetics."

Cybernetics, that application of electronic controls to provide thinking machinery, was just coming into use in 1955 but now, in 1995, it is doing most of the thinking for welding operations.

A few years ago acetylene chalk was used in flame-cutting, but this method has now become obsolete. When using acetylene chalk it was necessary only to mark along the line to be cut, after which the plate was placed in an oxygen-filled chamber with an electric potential across the plate.

Cutting Simplicity

None of that any more. Now we have nuclear cybernetics at work, and it is unnecessary even to touch the plate. However, engineers sometimes fail to letter dimensions clearly on the drawings, so "old cybernie" sometimes picks the wrong thickness of plate from the stockpile.

Without the plate selector, cutting to shape is easy and a 0.030-in. tolerance is maintained. Once the operating instructions are mastered, the cybernetic control dial is simply set to plate thickness and to the scale of the drawing. The drawing is then fed into the electronic-eye scanner, and the nuclear reaction button is pressed.

The cybernetic nuclear welder is even more amazing. The drawings it requires must be designed and traced with the greatest of care. Errors in the drawings are magnified by the electronic-eye scanner, producing bumps and cavities.

A Victory for AWS

One nice feature of this machine: it has solved a problem for AWS. The cybernetic nuclear welder will not work unless there are welding symbols to be interpreted.

After more than sixty years of struggling with this problem, AWS finally has the welding design engineer where it wants him—he must use welding symbols on his drawings.

The problems of proper shielding for the nuclear hand welder have been licked, too. While most production welding is now done automatically, the nuclear hand welder has become an important production tool for every industry.

It has made its greatest gains in the woodworking field, where its use has completely eliminated the necessity of glue and other adhesive materials.

For example, if the edges of two boards are to be joined to make one wide board, they are simply placed together and the nuclear hand welder is run over them. An atomic bombardment along the joint breaks up the molecules of the two boards momentarily and then allows them to reform, creating a permanent joint.

Welding Diversity

This amazing development makes it possible to join not only similar materials like wood, but also allows welding wood to plastics, to glass or to metal. It is an ideal means for laminating materials, even to the point of welding a floor covering to sub-flooring material.

The vast expansion of nuclear processes into the welding field have really brought welding into its own in 1995. It is impossible now for any industry to function without welding.

Who would have thought back in 1955 that highway traffic accidents, which were becoming the concern of all government officials, would, in the short space of 40 years, be eliminated completely.

The new welded cars, with their electronic controls and super-radar steering apparatus, are able to move through traffic rapidly, yet in complete safety.

In the field of home construction in 1995, everything is 100% welded. Even frame houses are welded now that the nuclear hand welder is being used universally. Welding, of course, makes all homes lighter in weight so they are constructed in a matter of hours.

They come completely equipped, with many of their unit features permanently welded in place. Best of all, their tightly sealed seams make them dust-proof.

Electronic Appliances

Electronics plays an important part in the home of 1995 for it is equipped with an electronic refrigerator as well as an electronic stove. Cooking and deep freezing take just a matter of seconds.

Accurate time has become a standard of the world because all clocks are wireless, and are timed by the Washington Naval Observatory. Wireless electric illumination also has become a fixture in American homes.

In the field of transportation, rocketry and the atom have taken over. Rocket planes now take off and land on roof tops, placing New York and San Francisco one hour apart by commercial airlines.

This form of supersonic travel is still expensive. Atomic fuel, however, has reduced the cost of rail and ship travel.

The world has advanced a great deal in the past 40 years. At last, people have come to realize the important role welding plays in their everyday lives, and how much it contributes to their comfort and happiness.

WELDING ENGINEER is the oldest and best-read welding publication, but we consider ourselves on the threshold of the greatest period of growth. *Seniority is wonderful, but we don't want to look back too often or too long—WELDING ENGINEER's youth, alertness and verve promise you more benefits in future years.*

WHERE WE STAND

At the 40-year mark, industry leaders take a thorough look at welding today.

THE birth of WELDING ENGINEER pre-dated my entrance into the welding field by many years, but I well remember those early exciting days. The weldors' slightest whim was law in most shops and the electrode coating was blamed for everything from impotency to falling teeth. Many times I found it necessary to eat some of the electrode coating to prove it was nonpoisonous.

Not enough credit has been given to the welding industry for its tremendous progress. During the past several years a specification-writing mania has seized many government departments and our own American Welding Society. It is to be hoped that this represents a temporary interim of growing pains because the future holds even more opportunity and promise for the welding industry than any time during the past.

E. J. Brady, President
Alloy Rods Co.

1915
Carbon-arc welding

THE TWO major developments in arc welding during the past 25 years, in my opinion, are:

1—A-c welding, which became practical with the development of suitable coated electrodes and arc shielding processes, and

2—Automatic and semi-automatic welding with submerged-arc and inert-gas processes.

Among the most promising developments now under way are the rectifier welder —a-c welders which preserve the inherent efficiency of the transformer, yet deliver the performance advantages of d-c—and the growing use of constant-voltage welding in automatic and semi-automatic processes.

I believe more will be done with CO_2 and inert gas. These processes must have many applications that will prove valuable in the future.

George G. Glenn, President
Glenn Co.

THE STORY of welding is a story of innovation—of growth. During this 40-year span of time, your magazine has recorded an account of nearly the complete history of the growth of welding. It has carried a vital share of the load in developing a full-fledged industry from a few basic inventions concerned with joining metals by fusion.

In looking back over the history of our industry, we have seen welding grow from an expedient method of repair and maintenance of metal parts to an indispensable method of fabrication.

Response by the engineers of our profession to the demand for new products has been remarkable. We are continually seeing new processes, equipments, and techniques developed to meet requirements of new metals or for faster, lower-cost fabrication.

With such a widening base of applications, the welding industry can look forward to vigorous expansion in size and in importance during the years that lie ahead.

C. I. MacGuffie, Manager-Marketing
Welding Dept., General Electric Co.

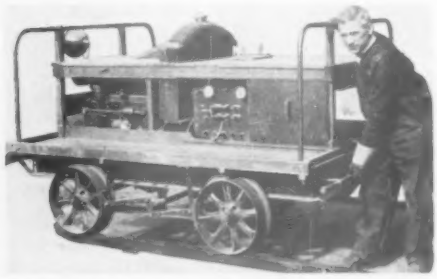
FOR A youngster of nineteen, $2,300 was a whale of a lot of money in 1908. I borrowed it to buy a complete welding outfit—acetylene and oxygen generators, three torches, a few bronze rods, cast iron sticks, rusty Swedish iron rods and a couple of pairs of dark glasses. With an additional $500 to cover rent and working capital, I was in the welding business.

And weld I did—Ford aluminum transmission frames, automobile frames, aluminum crank cases, frozen and cracked automobile cylinders (except on Cadillacs, they had copper jackets). How we welcomed a sudden cold snap. One quick freeze would bring in 20 or 25 cracked cylinders the next day and, at $7.50 each, we were on the profit side.

A few years later, Mr. L. B. Mackenzie asked my opinion about publishing a welding magazine, THE WELDING ENGINEER. I tried to discourage him, saying the circulation would be very limited, and that it would not be profitable for years. Fortunately for the welding industry, he disregarded my opinion.

What of the future? As Abraham Lincoln said, "The only way we have of judging the future is by the past," and, judging by the progress of the past, the future should offer unlimited opportunity.

Elmer H. Smith, Chairman of the Board
Smith Welding Equipment Corp.



1924: Gasoline-driven d-c welder for railroad repair work.

THE FACT that you are celebrating your 40th anniversary reminded this writer that he had been asked to prepare a feature article on resistance welding for the issue that would celebrate your *first* birthday. As a relative newcomer, I was undeniably proud to see my contribution in the feature spot.

It has been interesting to watch the progress made since that time. It has been an inspiration to have had even a small part in its development and expansion. My activities have been widespread over the years, during which time I have taken a keen interest in designing, building, selling and installing resistance welding equipment.

Your publication has played a very important part in helping expand the use of resistance welding, a most interesting process that will be given increased applications and more use than ever in the future.

Albert E. Hackett, Sales Engineer
Progressive Welder Sales Co.

IN THE early 1920's, the acme of arc welding technique was the dipping of mild steel wire in a bucket of whitewash. The acme of sales technique was to label all welding wire "Norway Iron." Debates in the American Welding Society were confined to one subject: "Which is the better process, arc or gas welding?"

Now we have volumes of specifications and performance codes. Although I cannot substantiate the statement, the tons of paper used annually in specifications and inquiries should equal the total tonnage of electrodes and gas welding rods produced in the early 1920's.

In the field of prophecy, one thing is very obvious: the continuing increase in automatic electric welding and, within that field, the increasing use of low alloys. So long as labor rates continue to rise as they did the past ten years, the use of automatic welding should grow in direct ratio.

W. H. Bleecker, Sales Manager
Page Steel and Wire Division
American Chain & Cable Co., Inc.

THE BIRTH of WELDING ENGINEER coincides almost exactly with an incident which attracted nationwide attention to arc welding.

Shortly after our entrance into World War I the government took over some interned German ships. The crews had tried to make them inoperative by damaging the engines. A thorough-going job had been done and the length of time estimated to replace damaged castings made it highly probable that the ships would be useless for the duration of the war.

Then, in an incredibly short time, the ships were termed ready for service. To the amazement of the general public it was learned that the answer was arc welding. The incident served mightily to give impetus to the expansion of the process.

Since that time, expansion of arc welding has been one of steady growth, sustained by improvements in power sources and the introduction of coated electrodes. Inert-gas shielding has made possible successful welding of many alloys and nonferrous metals.

Still more recently, the difficult-to-weld high-strength alloy known to the trade as 24-ST has been commercially welded by means of a highly stable arc and a coated aluminum electrode without inert gas shielding. It is along this line that I look for more startling developments in the future.

Klaus L. Hansen
Consulting Electrical Engineer

MY WELDING career started in 1908 as an ornamental iron worker in Frankfort, Germany, where both the oxyacetylene process and resistance welding method were employed. Considering the primitive equipment available, we produced excellent welds. In 1911, I came to San Francisco and soon became associated with a job welding shop. Customers were skeptical but, by taking large jobs

which appeared impossible to the average weldor, we finally proved that welding was here to stay.

In 1913 I developed apparatus with a special water-cooled torch to handle seemingly impossible jobs. With the perfection of the coated electrode, electric welding swept the field. We often wondered what would become of oxyacetylene apparatus, but soon discovered that the more electric welding employed, the more oxyacetylene cutting and welding apparatus was required.

As for the future, in view of time-saving processes now in existence, and the many new ones being developed, the potential for welding should be unlimited.

L. W. Stettner, President
Victor Equipment Co.

1922: Motor generator type a-c/d-c welder.

A LOOK back over the last forty years at the resistance welding industry reveals many amazing facts. Forward progress has been phenomenal. New techniques, designs and control devices have been so outstanding that the process has been transformed from an unreliable, little-known steel fabrication method to the method universally recognized as the fastest and most economical way of fabricating articles made from almost all metals and alloys.

To fully realize the extent of this outstanding progress, one only has to recall that 40 years ago only two types of resistance welding methods were known or used in industry. These were spot and butt welding. Today, flash welding has almost entirely replaced butt welding and, in addition, we have seam, projection, pulsation and percussive welding, electro-brazing and upsetting. Furthermore, we now have three-phase welding machines, where only single-phase equipment was available at that time.

Today we have devices built into welding machines for accurate setting and maintenance of predetermined amounts of control variables: pressure, time and current. There are now available over a dozen electrode alloys, all of which are more efficient and economical than pure copper.

Recall that there was almost no published technical literature on resistance welding 40 years ago. We now have outstanding handbooks, giving full descriptions of the process and a vast amount of technical data. In addition, there are now a number of monthly technical publications, continuously publishing up-to-date articles on the subject.

What lies ahead? The industry already is becoming automation minded. The trend is toward combining welding with other metalworking operations into multiple-purpose automatic units which eliminate costly handling operations. We do not hesitate to predict exciting and interesting progress in the industry which will inevitably mean more and better resistance welding.

P. M. Hall
Metalworking Equipment Division
Department of Commerce

FORTY years ago, the job of selling welding and cutting equipment was not quite as simple as, in many ways, it is today. In the old days you had to demonstrate that a torch would weld or that it would cut, and usually the demonstration was made on the toughest and most hopeless kind of a job.

Forty years ago, manufacturers of welding and cutting equipment had to teach each new customer how to operate the equipment. That was one of the costs of doing business. The purchaser did not buy just a torch; he bought a complete plant. Forty years ago the welding and cutting torches were repair tools and welding was considered only after something broke. Now, these torches have taken their rightful place in industry as production tools, in addition to being tools for maintenance and repair.

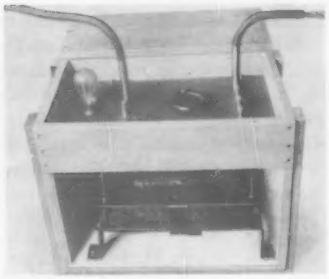
The welding industry as a whole has a proud heritage. So far as I know, it has never been subsidized by government funds. Yet, the processes of welding and cutting have played an important part in winning the past two world wars. In this atomic age, welding and cutting are playing and will continue to play an important role.

L. L. McBurney, President
Smith Welding Equipment Corp.

AS A "young oldtimer," I remember attending my first welding course 27 years ago while in college . . . about the time WELDING ENGINEER was in its "teens." The program listed instruction in both oxyacetylene and arc welding, but the secrets of arc welding were carefully kept from the students. On the last day, we were told it was too hazardous and that arc welding could in no way compete with the high quality results obtained with the torch. The difference today is that excellent publications like WELDING ENGINEER disseminate information freely about new welding processes.

Today, the emphasis is on arc welding and perhaps too little is taught about gas welding. We have advanced to using concentrated heat sources requiring less skill and experience. Arc welding, inert-arc and shielded-arc welding are becoming more and more important.

During my trips to foreign markets in all continents I have found welding to be one of the modern industrial techniques which has made the greatest strides in our lifetime. We see more welding in fab-



1918
Early a-c welder was used at Hog Island shipyard during world war I.

ricating and, of course, as a potent and powerful maintenance and repair tool.

Welding just will not stand still, which is why it needs a trade representative, spokesman and educational influence like WELDING ENGINEER. I look forward to continuing our personal and business association for the next 40 years.

Rene D. Wasserman, President
Eutectic Welding Alloys Corp.

THE WELDING industry has come a long way from the days when manufacturing coated electrodes consisted of buying a keg of wire rods, opening the top of the keg, pouring in some lime, nailing the top shut and letting the lime sift down through the rods. Modern extruding presses make precision-controlled coated electrodes faster than machine guns can fire bullets.

Only one thing has made this progress possible: the conviction that welding is the logical way to join metals. This conviction has sparked the industry to overcome obstacles inherent in the introduction of every new process. The industry first hurdled the problem of cost and learned to produce high quality equipment at low cost so the process became economically practical. Users have been quickly provided with necessary knowledge of both design and procedure. In this important work, WELDING ENGINEER has been a service to the welding industry.

Add to present growth that which will be created by future technological developments and you have an unlimited horizon. Metal joining is basic. As we improve it, we improve our standard of living by making things better and less costly. No industry in our country has better reason to face the future with confidence.

A. F. Davis, Vice President
The Lincoln Electric Co.

FORTY years seems a lifetime to the youngster, yet it is barely more than half a life-span by today's actuarial records. Forty years for a specialized process magazine to live is quite a spell and proves its worth to the industry to which it is dedicated.

In 1916, the fledgling welding industry had a champion who believed that welding was more than a tool to repair a pot, a pan or a stove grate. Those who have followed L. B. Mackenzie have put into print the successes and some few failures of welding. In spreading knowledge about welding through the years, WELDING ENGINEER has unquestionably made its mark upon man, his ability to make war and peace, his ability to provide comfort and ease the burden of his endeavors.

By its goodness, welding has come to be generally accepted even though its accomplishment is still a mystery to the average man in the street. May the success of WELDING ENGINEER in the next forty years lead to a still greater enlightenment and service to mankind.

R. L. Townsend
Tweco Products Co.

C. J. HOLSLAG was the inventor of the transformer type a-c arc welder, for which he was granted full patent rights. The original a-c welder was housed in a wooden box with handles.

During the early formation of Electric Arc Cutting and Welding Co. (now Electric Arc, Inc.), Mr. Holslag contracted for welding jobs of all kinds: industrial boiler repairs, welded structural work on New York bridges and buildings in Newark, N. J. Later, the company incorporated and started manufacturing d-c welders which, in the early days, comprised the accepted method of welding. However, Mr. Holslag, always an advocate of arc welding, found no support in this country and made a trip to England. Here he formed a company which developed an a-c welder that gained acceptance.

Returning to America, Mr. Holslag continued to manufacture a-c and d-c welders and welding electrodes. Many control features on d-c machines, such as the shunt indicator, were his ideas.

Instrumental, with others, in founding the American Welding Society, Mr. Holslag continued his outstanding work and achievements in the welding industry until his premature death in 1945.

The future of welding can only be a major endeavor and, with the advent of atomic power, metal joining is becoming increasingly important. Welding will be an important function without which there can be no progress in this realm.

Otto Kreisel, General Manager
Electric Arc, Inc.

TO HAVE lived with the welding industry and watched it grow from a toddling youngster to its present giant size is to have seen many startling and unique changes. My experience has been limited to arc welding with consumable electrodes, primarily on steel, and because of that experience I can make these observations and predictions.

The new high-speed, low-cost arc welding processes obviously will aid the growth of the welding industry. More welding will be done on those products now being partially welded, and steel products presently attached by other methods will be arc welded. A 3-in. weld will take less time than three spot welds. Fabrication of steel plate and bar stock will replace additional steel castings.

(Continued on page 62)

YOUNG lady, in dress of the period, shows how electrodes were given a cellulose coating in 1917. Several layers of paper were spirally wound on electrode and impregnated with water glass or sodium silicate.

A history of the coated electrode

BY JOHN J. CHYLE

IN THE author's thirty years of experience in the development of coated or covered electrodes, there has been a revolutionary change in these all-important welding tools.

Prior to 1917, the bare or washed or lightly-fluxed electrode was commonly used for electric arc welding. Some earlier attempts had been made to develop a heavier coated electrode of the all-mineral type. These electrodes had no gas shield, but their coating had ingredients designed primarily to stabilize the arc for easier manipulation.

While some patents did disclose the use of deoxidizing ferroalloy materials, we have no record or knowledge that these electrodes were used in the United States prior to 1917.

In 1917, a new concept was created in the use of gas-shielded electrodes. The gas shielding was accomplished by cellulose in the form of paper spirally wound around the steel core wire. Several layers of paper were applied, each layer impregnated with water glass or sodium silicate and then backed.

This type of electrode materially changed the quality of weld metal in that shielding now was given by considerable amounts of hydrogen and carbon monoxide. These gases were the end products of the disintegration of cellulose in the heat of the arc.

Needed Weld Quality

The quality of weld metal produced by these electrodes had the strength and ductility of the parent metal. Its first application was in the manufacture of small aerial bombs during World War I. Later, large quantities were used in the fabrication of welded couplings.

Quality of these welds had to be good because the inside of the couplings were machined and threaded. Any imperfections in the thread, therefore, would cause rejections. Millions of couplings were made between 1920 and 1925.

The paper-covered electrode was used on the longitudinal butt weld in couplings ranging from 5 to 18

Mr. Chyle, Director of welding research at A. O. Smith Corp., Milwaukee, Wis., is one of those credited with the development of the coated electrode as we know it today. Here is the story of that very important period in the history of welding as related for* WELDING ENGINEER's *40th anniversary issue by one of the industry's most famous pioneers.

in. in diameter and varying in wall thickness from ⅜ to ¾ in. Each coupling was carefully machined for accuracy of threads, and imperfections in the weld were a critical factor.

An attempt was made in 1925 to develop an electrode in which coating material could be extruded centrally around the core wire. Extrusion equipment had to be developed, of course, but only after coating formulations were devised which resulted in a plastic mass with suitable extrusion qualities.

It was soon discovered that the binder for covered electrodes was limited to one type of liquid, water glass sodium silicate. Today, there are several different grades of sodium and potassium silicates.

Yet, no other material has been developed that serves as well and as satisfactorily as sodium silicate for fire proofing, while giving the same binding qualities and permitting the incorporation of a plastic mass suitable for a high-speed extrusion.

Plastic Mixtures

The author's activity in this field began in 1925 and was primarily devoted to the development of experimental plastic mixtures. This work had already been started and had as its goal the commercial application of these mixtures to high-speed production of coated electrodes.

For several years, only one type of cellulose coating was used. The cellulose at first was wood flour; later, it was in the form of purified wood pulp. These early formulations were quite simple in that they contained only four coating ingredients in their makeup.

As electric arc welding applications increased, it was quite evident that electrodes with specific properties were desirable. The first type of extruded electrode was suitable for welding in the down-hand position.

It was apparent, however, that electrodes for all-position welding were necessary. After considerable experimentation, the use of cellulose in the form of wood flour, plus titanium dioxide, was developed for the first all-position electrode in 1927. This was the forerunner of our present-day E6010 electrode.

One of the early electrode types was termed a "hot rod." The coating was of a mineral nature containing a small amount of cellulose and a high percentage of iron oxide and ferro-manganese.

"Hot Rod" Advantages

This first electrode was developed for high weld metal deposition rates and materially increased welding speed. Furthermore, it gave noted improvements in the soundness of weld metal.

Early cellulose electrodes, while possessing ductility and strength, created blow-holes and gas pockets. These defects were not evident, however, until the use of radiographic weld inspection methods.

It is also true that early cellulosic electrodes, when properly made under the right conditions of formulation, processing and especially baking control, made perfectly sound welds. These electrodes, however, operated in a narrow range of arc length and current density to obtain the soundness that was desired.

With the advent of the hot rod, a new field for down-hand welding was opened. This electrode had wider ranges of current densities and arc length, while producing sound weld metal with good ductility and tensile strengths.

Successful Use of a-c

Shielding in all of the first electrode types was given by varying amounts of cellulose, together with deoxidizers in the form of ferro-manganese or other ferroalloys.

Development of the rutile electrode type made the successful use of a-c welding possible for the first time. While a-c welding could be applied to cellulose electrodes, the spatter was too great to cope with.

The rutile electrode, largely a mineral type with small amounts of cellulose to give proper arc action, definitely established the advantages of a-c welding for special applications where magnetic interference was an important factor, and particularly in fillet welds.

Next in the line of important electrode developments was a special rutile electrode having substantial amounts of cellulose. This differed from the rutile mineral type in that sound weld metal could be deposited that would meet established radiographic standards.

The rutile mineral electrode type did not deposit weld metal that was sound in multi-pass welding procedures, however, and was not applied where high standards of soundness were required.

Millions of pounds of rutile cellulose electrodes were used during World War II, and this electrode type materially aided the war effort in the fast production of welded tankers and ships of all kinds.

During the war, also, a new electrode type was developed which is now commonly referred to as the low-hydrogen type. At first, these electrodes were made with alloy steel core wires for welding armor plate where under-bead cracking was a serious problem. Later, these electrodes, with mild steel core wire, were applied to mild carbon steel weldments of all types.

Low-Hydrogen Electrodes

The manufacture of low-hydrogen electrodes was so designed that hydrogen in the coating was reduced to a minimum by eliminating all organic or cellulosic material, and by the use of materials that did not con-

ONE of the first high-pressure oil vessels to be electrically welded with coated electrode was shipped to Texas on July 25, 1925, for use as a cracking still. Wall thickness was 2½ in., and over-all length was 41 ft.

tain chemically combined water.

It was necessary to bake these electrodes at high temperatures to drive out water contained in the binder of either the sodium or potassium silicates used. Storage has to be carefully controlled so that the absorption of moisture will not reincorporate water into the coating.

Shielding obtained with low-hydrogen electrodes is still gaseous. Large amounts of carbon monoxide are produced from the composition of carbonates used in the coating.

Calcium carbonate or finely-crushed limestone is one important ingredient of the low-hydrogen electrode. In the high temperature of the arc zone it decomposes first into carbon dioxide, then into carbon monoxide.

Later, in the outer zone of the arc, carbon monoxide recombines with oxygen and again forms carbon dioxide. With this electrode coating type it is also necesary to use ferromanganese and ferro-silicon to obtain the complete deoxidation of weld metal necessary for sound production.

Tensile Strength Range

With the advent of low-hydrogen electrodes, it was seen that this electrode could be produced in a variety of different types. Alloying additions could be made to give a wide range of tensile strengths, from 70,000 psi to 140,000 psi, depending upon the amount of strengthening alloys incorporated in the coating or core wire.

It was also possible to introduce ingredients which would permit the use of both a-c and d-c. These electrodes are now designated by the American Welding Society as the XX15 or XX16 types

The latest development in the field of coated electrodes is the iron-powder electrode type. This electrode may have originated in Europe, where it was known as the "contact" type.

A short arc length can be maintained with iron-powder electrodes, and the arc is initiated by bringing coating in contact with the workpiece. Approximately 50% of the electrode coating is iron powder.

Iron powder electrodes are relatively thick, giving a substantial increase in the amount of coating on the core wire. Deposition rate was materially increased, and this electrode type found ready applications for high-speed fillet groove welding.

In recent years, modifications of the iron-powder electrode have incorporated alloys for high strength, and led to the production of a low-hydrogen iron-powder electrode. Latest development in the latter electrode is its all-position quality, and the freedom from flakes or fish-eyes when used with the proper welding procedure.

Low-hydrogen iron-powder electrodes have to be carefully manufactured so that hydrogen content is reduced to about the same value as in the standard low-hydrogen type where no iron powder is used.

—Courtsey Fibre-Metal Products Co.

BARE-wire carbon-arc welding was used as far back as 1904 in the welding shop at Baldwin Locomotive Works. Weld on a cracked cast iron locomotive cylinder often took 72 hours to complete.

Special Modifications

In addition to the main electrode types that have been developed, other special types have been modified, some slightly, others more extensively, to give special properties. The rutile mineral type can be classified as hot, cold or intermediate, depending on the welding application.

Manufacturers are modifying electrodes for the special needs of industry. Characteristics have been changed for special usage in the automotive industry, for example, where extremely high-speed, high-current-density applications are required.

Light-gage electrodes have also been developed in 1/16 to 3/32-in. diameters for sheet metal welding. These are special rutile mineral types modified to give good arc stability at low currents with minimum burn-through and good weld appearance.

In the development of electrodes, the engineer must give consideration to these prime factors:

1—Mechanical and physical properties of weld metal.

2—Appearance of the weld bead for uniform and pleasing appearance. Visual examination is a basic weld inspection method and good appearance is important from a commercial viewpoint.

3—Weldor's appeal. Arc-welding characteristics are very important to the weldor, who judges electrode performance by ease of manipulation, freedom from spatter and a stable arc.

4—High-speed weld metal deposition.

5—The manufacture of electrodes for extrusion at high speeds with a minimum of scrap loss.

Further electrode improvements will continue to be made. Low-hydrogen and iron-powder electrodes, as well as cellulosic electrodes, will probably remain in use for a long time.

Undoubtedly, there will be future electrodes that are not sensitive to moisture absorption. They will have wider ranges of current density and will require less skill on the part of the weldor.

The electrode types presently available to industry are a tribute to the research men who have so successfully developed them. A great many individuals have given their best efforts in this vast program that has given—and will continue to give—lower manufacturing costs because of greater speed with high-quality weld metal.

With welding torch and electrodes . . .

"Old MacD." goes modern

WITH the harvest season at an end, or very nearly so, America's farmers will once again be taking stock of all the maintenance and repair jobs that must be done during the slow winter months.

Welding will play a part in the care and improvement of farm equipment—a very big part, for it is the one metal joining technique that can be used by the greatest number of farmers.

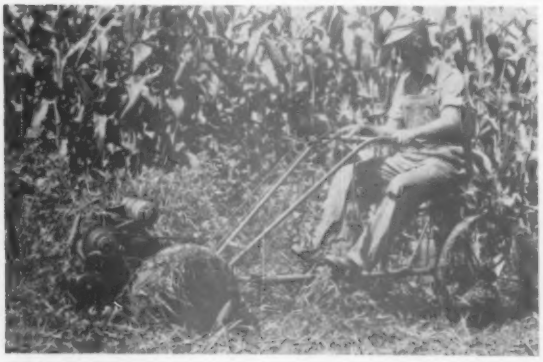
Portable welders may still be considered a luxury, even by those farmers who own them, but they have proved their worth and are rapidly becoming as vital to the farm as the tractors and plows they so often repair.

The pictures on these pages indicate the varied and valuable uses to which welding processes have been put by several Iowa farmers. Where the dollar savings these men have been able to make through the use of welding are not stated, they can readily be estimated. *(Photos by A. M. Wettach, Mount Pleasant, Iowa.)*

SELF-FEEDER of welded deck plate fits between two farrowing pens for use by sows and pigs in both pens. Top is uncovered for easy filling from aisle of hog house. Bolts are used only to anchor feeder to boards to prevent rooting damage. Jon Kneen of Mount Union, Iowa, welded small rods to edge of trough to round edges and prevent injury.

PIPES welded to three I-beams form the frame for this cattle guard on the Elmer P. Ball ranch near Briggsdale, Iowa. Three additional rods are tack-welded across all the pipes as added reinforcement. Fenders on each side are also welded, together with bracing rods.

WELDED extension carries crop and weed sprayer behind tractor. Stub axles welded to short lengths of channel iron raise the frame to clear short corn. Spray arm can be raised on upright welded frame at the rear to handle tall growing crops. This easy-to-build device is the work of Lloyd Marek of Washington County, Iowa.

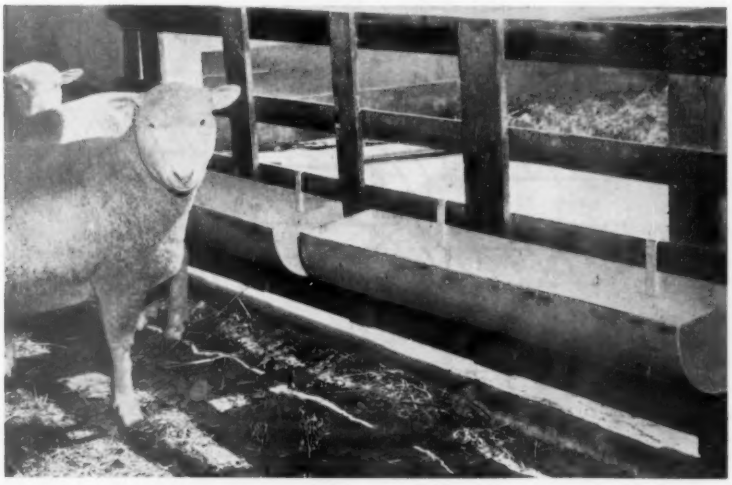


HOME-MADE cart, attached to garden tractor with its weed mower, takes the strain out of fence mowing when weeds and corn are high. Clifford Cruzen of Wright, Iowa, welded together odd parts from scrapped machinery around his farm to make this cart.

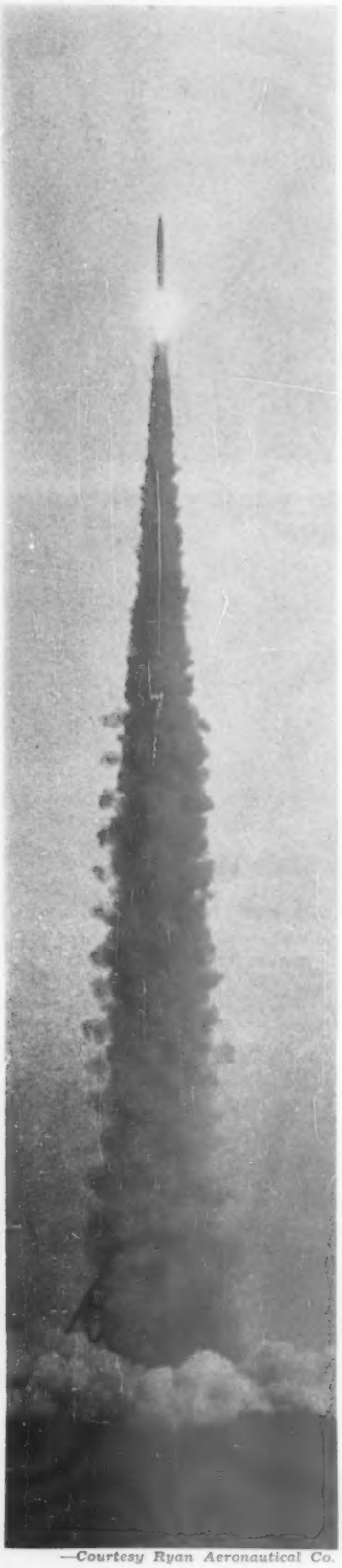
RIGHT: Welded bull-dozer was fabricated from used material on the farm of Clarence Robertson, near Donnellson, Iowa. Frame of attachment is 4-in. channel iron, with a strap welded on top to box in the irons. Part from old grader was welded on blade to provide a cutting edge, and angle iron welded to back of blade provided reinforcement. Total cost was $125—compared to possible $1,500 factory price.

ORIGINALLY built to move sows in hot weather, this all-purpose welded trailer has seen almost daily use on the John Miller farm near Olds, Iowa. Frame is 4-in. pipe, with 2-in. flat iron braces at the corners. The 5 by 6-ft crate inside the frame can be lowered for ground-level loading. Stock capacity is three sows or one cow, and the trailer cost only $160.

THREE-WHEELED tank wagon can easily be maneuvered close to windmill pump for filling. All-welded tank is sheet steel, and an auto chassis forms the frame. The front axle of an auto is used, with spindles and arms welded. Cross-braces are welded rods and angle irons. The tank is raised at the rear so that it can empty directly into a water tank on the ground.



LEFT: Troughs built originally for show sheep take up a minimum of pen space and can be used for both grain and water. Steel of the type used in farm gas-storage tanks was selected, and heavy strap irons were welded to trough for attachment to pen. Corridale yearling rams posed for this picture on the farm of Kenneth Wagner, near West Liberty, Iowa.



—Courtesy Ryan Aeronautical Co.

See industry-wide applications

"Futuristic" Rockets will soon provide economical energy

BY JAMES A. BROWNING*

PRESENTLY, the only commercially successful use of rocket energy in an industrial application is the so-called "jet-piercer."

This device makes use of a high-temperature, high-velocity rocket exhaust to drill blast holes in taconite—an extremely hard type of iron ore. Conventional drilling techniques cannot match the effectiveness of this unit.

The possible use of small-scale rockets in other fields has received only cursory mention to date. In the past year, a further investigation of industrial uses for rockets has been made at Thayer School of Engineering. Several different types of rocket devices have been developed and applied to a variety of jobs.

A suggested list of rocket applications in industrial processes includes:

Heating torches; flame-cleaning; steam cleaning; flame-hardening; material atomization, and grit and liquid blasting.

One experimental rocket had an exit throat diameter of only ⅛ in. It was fueled by a mixture of propane cooking gas and oxygen. Velocity of the jet produced by expansion of burning gases was nearly a mile a second, and the temperature of this jet was about 5400 F.

Rocket Principles

Machined from brass, all rocket joints are silver-soldered. The simplicity of such a device is shown by the sketch in Fig. 1.

The forced water cooling system consists of a coil of 3/16-in.-diameter copper tubing silver-soldered to the outer surface of the rocket. (Other designs may incorporate cooling jackets or drilled passages.)

The injector design is critical in that improper positioning of these holes may cause an unwarranted noise level.

A rocket metallizing unit, properly designed, operates at a noise level of 98 decibels, equivalent to that of the corresponding air-blast metallizing gun. An error of only 1/64 in. in the spacing of these injector holes can lead to a noise level of over 140 db.

*Assistant professor, Thayer School of Engineering, Dartmouth College.

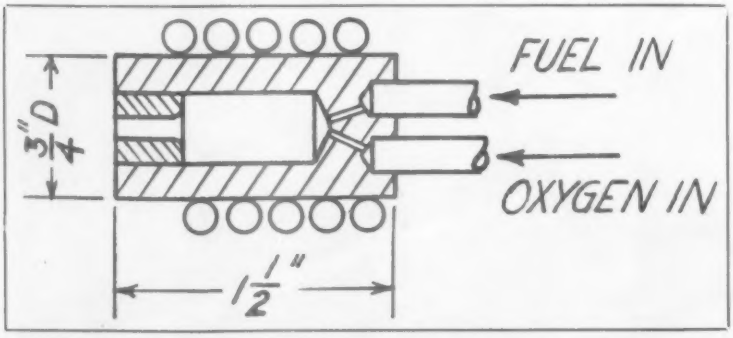


FIG. 1—Tiny rocket with ⅛-in. exit throat diameter produced jet velocity of about one mile a second and a temperature of 5,400 F.

Oxygen for combustion is provided in gaseous form from a conventional high-pressure tank at a regulated pressure of about 100 psig. Pressure of propane in an LPG tank is a function of its temperature, and is about 120 psig at normal temperature.

Fuel Pressure

Full tank pressure is used to force fuel into the combustion chamber. Ignition is provided in a conventional manner by spark-lighting a relatively small flow of gases.

The flame formed outside the rocket can be made to flashback into the combustion chamber by proper adjustment of flow valves. Once the flame burns properly within this chamber, fuel and oxygen flows may be greatly increased to produce desired rocket-jet characteristics.

Evidence that a jet is travelling at sonic velocity or higher is provided by the presence of a series of seven visible "shock diamonds." In this case, pressure within the jet as it issues from the rocket is higher than that of the atmosphere.

Subsequent attempts to equalize these pressures can only be transmitted into the jet at sonic velocity. A sketch illustrating this process is shown in Fig. 2.

Two-Dimensional Flow

Assume the flow to be two-dimensional. Two rarefaction waves travelling at sonic velocity penetrate into the jet from points *a* and *b*. Regions *c* and *d* are thus at atmospheric pressure.

Due to overexpansion of the jet, region *e* experiences sub-atmospheric pressure. The rarefaction waves travel completely across the jet and strike the boundary between the moving stream and the stationary atmosphere. Each wave reflects from this boundary and tends to converge. The two waves intersect to form shock fronts.

A sudden pressure increase is experienced by the fluid crossing these shocks. Combustion processes are intensified in these shock zones, and areas of shock influence become visible.

Original conditions are once again established, with jet pressure higher than atmospheric. The cycle repeats itself and another shock diamond is formed further downstream.

Due to losses of available energy, each succeeding shock becomes less intense, until a point is reached where the pattern is no longer evident.

Even though the temperature of a premixed oxyacetylene open flame is about 600 F higher than that produced by the propane rocket, the latter device is considerably more effective when high heat transfer rates are desired.

Flame-Cleaning

Several of the applications utilize both high velocity and high temperature of the rocket jet. These include flame-cleaning, steam cleaning, and material atomization.

Flame-cleaning requires rapid heating of surface deposits to produce differential expansion of these deposits in relation to the base metal. The greater this differential expansion, the more efficient the process becomes in terms of percentage of deposits removed.

High kinetic energy of the rocket jet provides a violent scouring action which further increases the effectiveness of the rocket for this application. Flame cleaning speeds have been found to be nearly three times those of an open oxyacetylene flame.

Fig. 3 shows a multiple-port flame-cleaning rocket with full intensity combustion occurring. Note how small the active combustion area is.

An open flame of equivalent heat output would cover a much larger expanse, and in many cases could be considered a more dangerous fire hazard.

This rocket cleaner can remove a thick coating of aluminum paint at a travel speed of 12 ft per minute. An open propane-oxygen flame, stabilized beyond the orifices of this unit, could not remove this aluminum paint.

Allowing the flame to flashback, and adjusting flow rates to equal those used for the open flame test, produced a rocket action which proved quite effective in its cleaning action.

Steam Rockets

A multiple-port rocket tends to leave its comb pattern on the surface being processed. In many applications this is not a desirable feature. Case hardening operations require uniform temperature across the steel surface, so the slot-exhaust rocket with its more even flame distribution is called for.

Water may be introduced into the rocket without effecting combustion stability by providing a secondary chamber as shown in Fig. 4. Relatively large flows of water produce the characteristic wet-steam spray of commercial steam cleaning equipment.

Detergents may be dissolved in the water to aid cleaning action. Except for equipment involved, comparable results would be expected when comparing the steam rocket and present methods of steam cleaning.

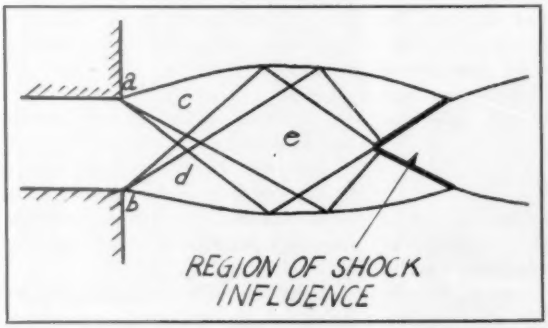


FIG. 2—Sketch indicates formation of shock diamonds as air jet issues from rocket at supersonic speed. This indicates jet pressure greater than that of the atmosphere.

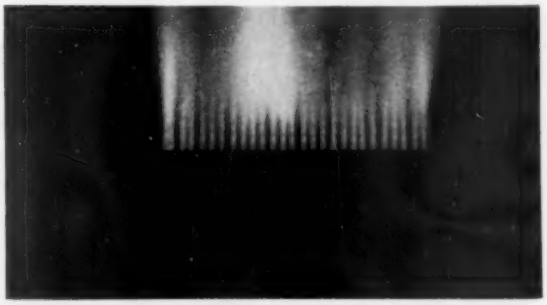


FIG. 3—Shock diamonds are clearly visible as this multiple-port flame-cleaning rocket develops full combustion intensity—nearly three times that of open oxyacetylene flame.

During the investigation of possible applications of rockets in steam cleaning, no results beyond the duplication of performance of conventional systems were anticipated. A remarkable change in type of action produced by this rocket is brought about by reduction of the water flow below a critical value.

This point is reached when the quantity of water is not sufficient to quench the flame reactions taking place beyond the point of water injection. In this condition, the flame takes on a distinct green-yellow color and the jet remains in the supersonic region.

Reducing Action

This jet has a strong reducing action. It chemically removes rust from surfaces which cannot satisfactorily be cleaned by other flame or rocket cleaning techniques.

It is also quite effective in removing oil deposits. Fig. 5 shows a once rusted and oil-covered piece of steel. The middle portion shows the specimen in its original state.

The clean portion on the right has been steam cleaned. The section on the left has been rocket cleaned, but without water injection. In the last case, a charred layer of burnt oil remains.

The strong reducing action of this jet can perhaps be accounted for by the presence of such agents as cobalt, carbon and hydrogen. The amount of injected water controls the degree of quenching of combustion processes.

A rapid cooling would "freeze" these reducing agents long enough to allow them to reach the surface being cleaned. For a surface held one inch from the point at which water enters the jet, and assuming a lowered jet velocity of 3,000 fps, the life of these agents would have to be only 25 microseconds.

FIG. 5—Center of steel bar shows original rusted, oil-covered state. Rocket cleaned area is at left; a layer of burnt oil remains. Steam-cleaned area at right indicates near-perfect dirt removal.

Rapid Reaction Rates

In addition, a high temperature (3,000 F and above) is provided for reducing action to take place. The effect of this high temperature is to allow extremely rapid reaction rates.

Thus, a careful balance between carrier concentration and jet temperature must be maintained to effect optimum cleaning results. The steam rocket, when adjusted to give the reducing jet, does a creditable job in cleaning various non-metallic materials.

In some instances, the intensity of rocket energy is too great to do conventional jobs. An example of this is given by those flame-hardening applications requiring relatively deep penetration of the hardening effect.

If heat is transferred to a metal at a rate greatly exceeding the heat conductivity of that material, surface layers rapidly become molten with little heat penetration beyond. Some rockets will begin to melt the surface of a 2-in.-thick piece of steel in 1.5 seconds.

Not for Hardening

To insure a deep zone of hardened steel, the rocket's fuel and oxygen flows must be reduced to a level which will produce a heat source comparable to that of an open flame. Thus, there appears to be little opportunity for rockets to perform conventional flame-hardening operations of this type.

In conventional flame-hardening operations the rocket is not applicable. However, with its high heat input rates it is possible to case-harden a surface to a depth of only a few thousandths of an inch. In many cases, the presence of a large mass of relatively cool steel below this thin layer is a most effective heat sink and serves as an adequate quench.

Rocket Metallizing

The most spectacular use of a rocket device in an industrial application is the rocket metallizer. Fuel is supplied at tank pressure directly from a conventional propane cooking gas tank. Oxygen is supplied at 100 psig.

The metal rod to be sprayed passes through the throat of the rocket where it is heated to its fusion point. By proper adjustment of the rod feed rate, the fusion point is reached at a position beyond the throat exit.

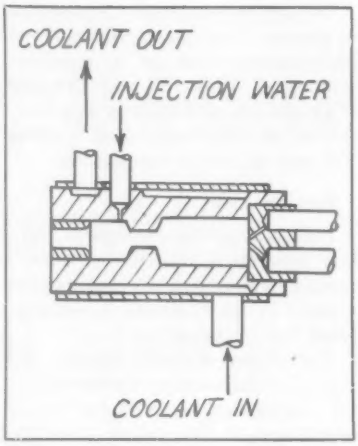


FIG. 4—For steam-cleaning applications, water can be introduced into jet. Detergents may be added to water to speed process.

The additional heat and kinetic energy of the jet melts and atomizes the rod into a fine spray. This spray is hurled at high velocity against the surface being metallized.

Results obtained to date indicate that the rocket metallizer can produce a more homogeneous distribution of particle sizes than is possible with conventional air-blast guns. Also, the mean particle size can be made smaller.

A cursory investigation of the use of rocket energy to make a fine grade of glass wool has been made. A ⅛-in.-diameter glass rod, fed through the metallizer unit, produces the wool.

Resulting fibers have a wide range of diameter. However, a large number of these fibers have diameters between 1 and 2 microns, while the remainder range up to about 30 microns.

Use of rockets in the field of grit and liquid blasting has not yet been investigated. By a technique similar to that used in water injection devices, it should be a simple matter to introduce particles, or slurry, into the high-velocity jet.

Reduction of rocket principles to industrial applications is a fascinating field. Without doubt, the future will see many practical applications of these high-energy devices.

FIG. 1—Welding positioners come in many sizes with varying load ratings. This manually operated unit is one of the smallest made.

Welding positioners

Set the stage for weld quality and greater speeds

BY ERNEST L. RICHMOND*

THE SCIENCE of welding has grown to its present proportions in approximately 50 years—well within the span of a man's life. Although forge or pressure welding was known and used as far back as the 13th century, it was not until the latter part of the 19th century that thermit, gas and electric arc welding were introduced.

The flux electrode was developed about 1910 and from that time on, welding showed tremendous growth.

This comparatively new giant of modern industry has been responsible for rapid development and growth in still another field: welding or work-positioning equipment. This equipment has been engineered for use

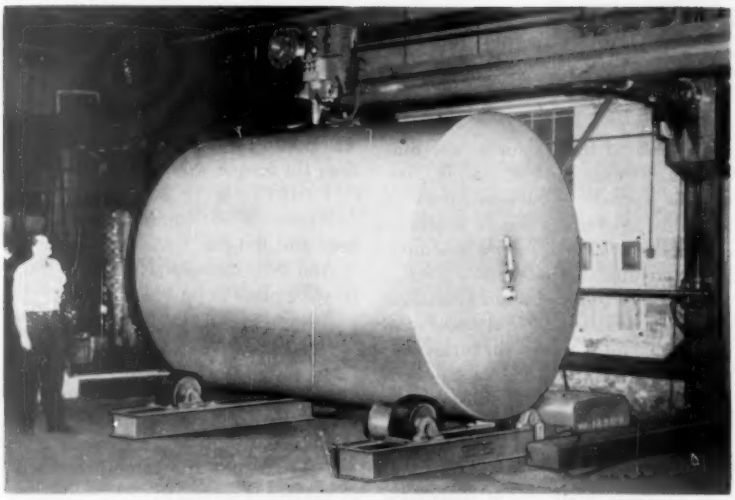


FIG. 2—A very useful type of weld positioning equipment is the roller for pipe welds. This relatively small unit positions the work beneath an automatic submerged-arc welder.

*Asst. chief engineer, Plainfield Works, Worthington Corp.

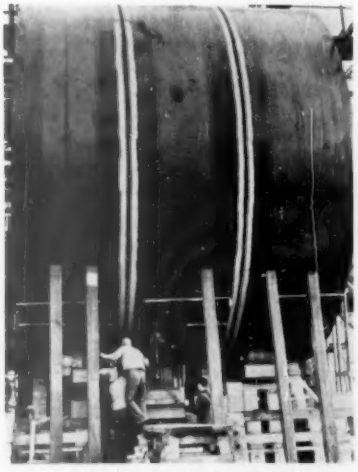


FIG. 3—One of the largest power rollers made turns a hull section of the atomic-powered submarine *Nautilus*.

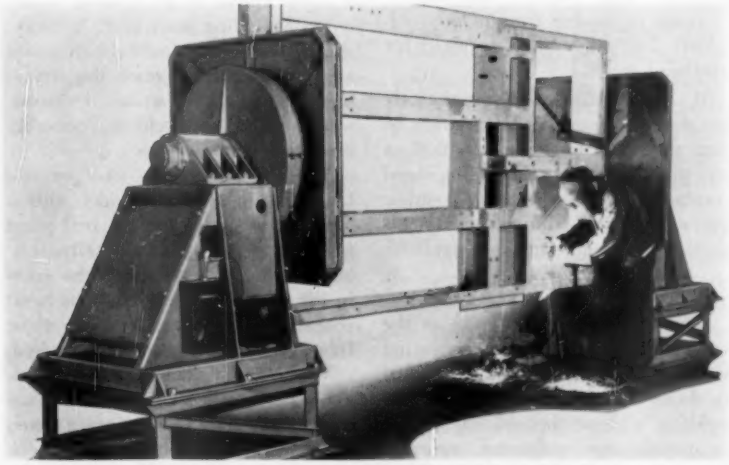


FIG. 4—Headstock in the foreground turns the workpiece while the tailstock serves as an idler. These units will handle pipe and framework that need only be rotated.

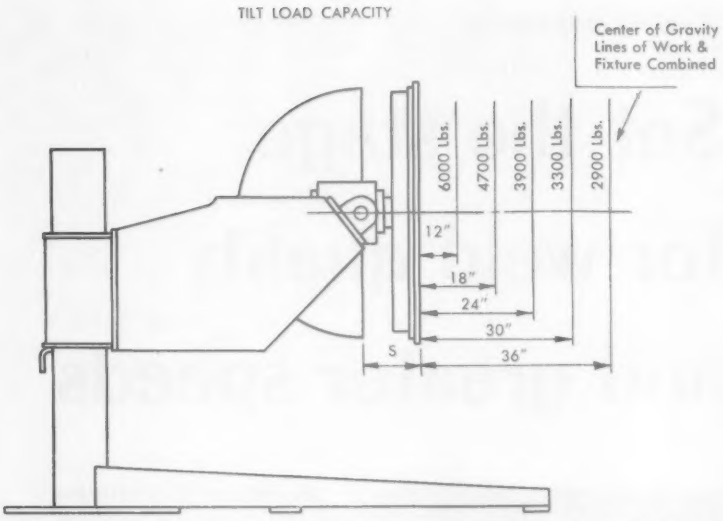


FIG. 5a—Diagram shows ratings based on a center of gravity from 12 to 36 in. from the positioner table. Tilt torque must be accurately determined to prevent mishaps.

with welding in an effort to produce the best in weld quality and, of course, increase production.

Positioners originally were constructed to fit particular needs of the shop in which they were used, and were designed and built by shop personnel. Now, after 25 years, they have grown into a new industry closely allied to modern welding and assembly work.

Chief aim of welding positioner design is to place work in a position most advantageous to the weldor, keeping both fatigue and operator factors to a minimum.

It is an accepted fact that the best welds are made in the downhand position. This position permits an increase in joining time of approximately 280% over that required for overhead welds.

If work is tilted approximately ten degrees from the flat position so that the weld is made downhill, a still greater increase in welding speed results. Positioners provide positive, controlled means for placing welds so that these gains may be realized.

Operator Factor

Operator factor is defined as the ratio of time consumed in laying weld metal to total time consumed in doing the entire job. For general welding without the aid of fixtures or positioning equipment, operator factor is usually 20 to 25%. When fixtures and positioners are used, operator factor is about 45 to 50%.

The use of this factor is not limited to welding operations. It may also be applied to various forms of assembly operations where positioning of the work will reduce assembly time and operator fatigue.

For the purpose of a more detailed treatment, positioning equipment may be divided into three categories:

(1) Welding or work positioners
(2) Headstocks and tailstocks
(3) Turning rolls

Certain salient points must be considered in the selection and application of these machines if maximum economy is to be realized.

Varying Sizes

The positioner in the first category is better known to the welding industry as a welding positioner. Actually, work positioner would be a more appropriate name, since the equipment serves to position the work whether it is for welding, assembly or some other purpose.

Welding positioners vary in size from the small table model with a capacity of 100 lb to the real giant rated at a 100,000-lb capacity. The baby is seen in Fig. 1, and the giant in Fig. 7. Smaller units may be hand operated or power driven, while larger units are completely powered.

Welding positioners, in general, are rated to carry definite loads whose centers of gravity are a given distance above or out from the work table, and a given distance off the center of the table (Fig. 5, a and b). It is apparent that weight of work piece and attaching fixtures—and their centers of gravity—must be known before the proper size positioner can be selected.

Rating Equations

A typical rating might read 6,000 lb maximum load at 12-in. center of gravity above the table and 12-in. eccentricity. In addition to this information, rotational speed range and tilt speed of the table would also be given.

If the machine has constant rather than variable speed for table rotation, that fact will appear in the specification.

The product of load and perpendicular distance between the load and the axis of rotation is defined as torque. In one case, the product is tilt torque, and, in the other, rotational torque.

As an example, if the combined center of gravity of load and fixture was 36-in. from the face of the table, then tilt torque would be:

T (tilt) = W (S+36)

Where W = combined weight of load and fixture

And S = distance from table face to yoke pivot point.

Allowable tilt torque, of course, would be 2,900 (S+36) if the machine shown in Fig. 5a were used.

In Fig. 5b, rotational torque is obtained by taking the product of the combined weight of load and fixture, and the amount the combined center of gravity is eccentric.

T (Rotation) = We

Where W = Combined weight of load and fixture

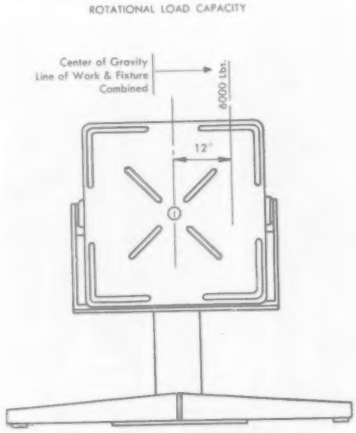


FIG. 5b—The product of the combined weight of load and fixture, and the amount the combined center of gravity is eccentric, gives rotational torque.

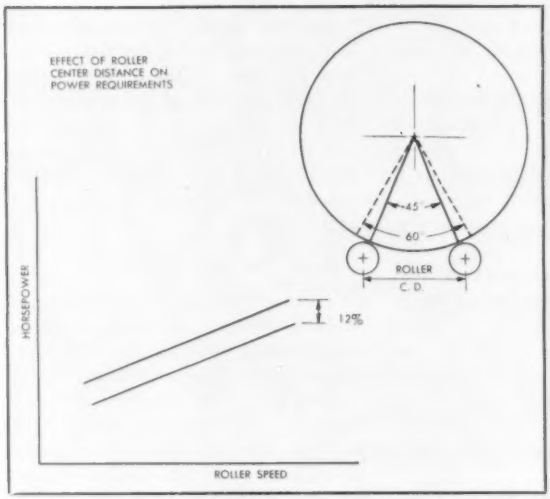


FIG. 6—When using turning rolls, the roller center distance should be no greater than an included angle of 45 deg. This will prevent rolling resistance and an overload on the rollers.

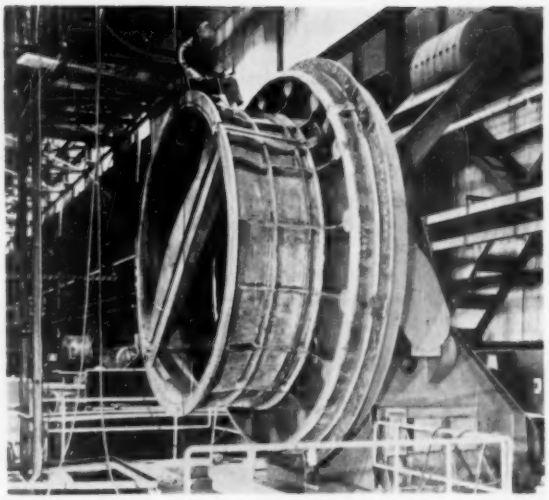


FIG. 7—Rated for a load capacity of up to 100,000 lb, this welding positioner is the real giant in its field. A portable platform enables weldor to reach top for downhand welds.

And e = Eccentricity

Allowable rotational torque for the machine in Fig. 5b would be 6,000 (12) lb-in.

Torque is not an awesome factor. It is one of engineering's most important terms, and especially important in the positioner industry. It is directly related to horsepower and speed and deserves consideration when applying positioning equipment to a specific job.

The relationship of horsepower, torque and speed can be expressed by a classical equation which is always fulfilled:

$$\text{Horsepower} = \frac{\text{Speed} \times \text{Torque}}{\text{Constant}}$$

A study of welding positioners will reveal a point for both tilt and rotation at which torque will be a maximum. It is this maximum torque for which component parts must be designed and upon which rating charts are based.

Power Curve

In the case of rotation, the curve of power required at the table for various positions of the load during one revolution will result in a modified sine wave. This curve is actually the duty cycle from which power requirements are determined.

If power required for one revolution of the table is plotted against table speed, the curve will indicate a constant-torque application.

This is very important, and reference to the above equation shows that with torque remaining constant, any increase or decrease in table rotation speed must be accompanied by a corresponding increase or decrease in horsepower.

In other words, if table rotation speeds in excess of those listed in the ratings are desired, more horsepower must be provided for a given torque. Of course, if torque were reduced by reducing the load or load eccentricity, then for a given table rating the speed could be increased without changing motor size.

Fig. 8 shows a typical constant-torque application into which welding positioners generally fall.

What is Torque?

Torque is the product of applied force and the perpendicular distance from the axis of rotation to that force or:

$T = Fd$

This equation states that for any given torque, any increase in lever arm or distance (d) must be accompanied by a decrease in force "F" or vice versa. Since welding positioners are rated for certain forces at a given distance from the table and center of rotation, maximum tilt and rotational torque is established.

Thus, the equation offers a means for obtaining various combinations of force and distance so long as their product-produced torque does not exceed the allowable maximum.

Distance used in the torque equation denotes distance from the axis of rotation to the load's center of gravity. Center of gravity of the workpiece is an extremely important factor, and absolutely essential to an intelligent determination of safe work positioner size.

Second Category

The second positioner category includes headstocks and tailstocks. These are special types of welding positioners with vertical tables which cannot tilt. Headstocks are powered for table rotation of 360 deg, and the tailstocks serve as idlers. They are usually used in combination (Fig. 4).

Both, however, may also be used with other types of positioning equipment. Previously stated welding positioner ratings apply also to these machines.

The third category lists turning rolls, including power and idler rolls. A power roll resembles a roller skate turned upside down with driving power applied at the rollers.

The idler roller is similar, but without power at the rollers. Rollers may be obtained with rubber or steel tires. The outboard roller is usually adjustable, and some designs permit adjustment of both rollers.

Longitudinal Welds

When power and idler rolls are mounted on self-propelled rail cars, longitudinal welds can be included in their sphere of operation. The rail cars may derive their power from an

independent unit or take it from the turning-roll power unit.

Here again, the machine is designed to provide quick and economical work positioning to give maximum weld quality and production. When this unit is used in conjunction with a universal welding manipulator, it becomes a versatile piece of equipment.

Turning rolls are made in various sizes to accommodate a wide range of loads. Smaller units may have capacities of only a few tons, while larger units may be rated to handle several hundred tons. Fig. 2 shows one of the smaller machines in operation. In Fig. 3, one of the largest power rollers turns the hull of the atomic-powered submarine, U.S.S. *Nautilus*.

The hull load was in excess of 400 tons, emphasizing the tremendous growth in the capacity of turning rolls in the past seven years. In 1948, a turning capacity of 75 tons was considered tops.

Turning and idler roll ratings are based on turning and carrying capacities. Torque plays an important role in this system, and is used in the design of component parts of the driving mechanism.

More Torque Needed

These units are rated on roller surface speed, and the relationship of speed, horsepower and torque is just as true for this equipment as for welding positioners and headstocks. This may also be classified as a constant-torque application and any increase in roller surface speed must be accompanied by an increase in horsepower.

Naturally, more torque is required to turn a given tank on rubber-tired rollers than on steel-tired rollers. Chief function of rubber tires is to cushion seams and tank surface irregularities and offer a non-marring, rolling surface.

In performing this function, they automatically add resistance to turning due to their deflection. Torque to turn the tank, while essentially constant for a given load, is therefore dependent upon normal tire load, tire deflection and uniformity of tank surface. It is independent of roller surface speed.

For a given torque, the load that can be turned on steel-tired rollers varies between 1½ and 2 times that which can be turned on rubber-tired rollers. These facts form the basis for rating tables set up by manufacturers of this equipment.

Load-carrying capacity of turning rolls is equally as important as turning capacity. This value is dictated by shaft design, frame design, bearings used, roller design and roller tire capacity.

When using steel-tired rollers, width of roller must be considered in relation to tank weight and material. It is possible, with steel-tired rollers holding thin-walled tanks, to have unit pressures at the rollers high enough to shear or buckle the shell. The use of extra idler rolls will overcome this difficulty.

Another factor to consider when using turning rolls is the distance between centers of the rollers in the plane of rotation of the work. True load on each roller is the normal load which is dependent upon the included angle formed between the workpiece axis of rotation and points of contact at the rollers.

Roller Distribution

Therefore, as roller center distance is increased for a workpiece of given size, normal load on the roller increases and rolling resistance also increases. In order to keep rolling resistance to a minimum, the center distance between the rollers should be adjusted so that the included angle remains at approximately 45 deg.

In the past, an included angle of 60 deg was considered ideal, but a decrease in required horsepower of approximately 12% can be realized merely by reducing this angle 15 deg.

It may be stated that any included angle of 45 deg or less will provide optimum operating characteristics. Of course, this angle must never be reduced to the point where work tends to roll off the rollers.

A thorough knowledge of the relationship of horsepower, torque and speed can be of inestimable value in selecting and applying positioning equipment. The combined center of gravity of the work and fixture, as well as maximum operating speed, are at the top of the list of items to be considered by user and manufacturer when selecting positioning machinery.

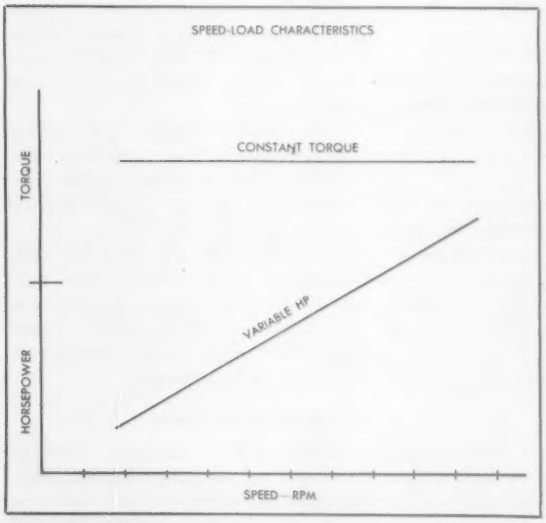


FIG. 8—This chart shows a typical constant-torque application into which welding positioners generally fall.

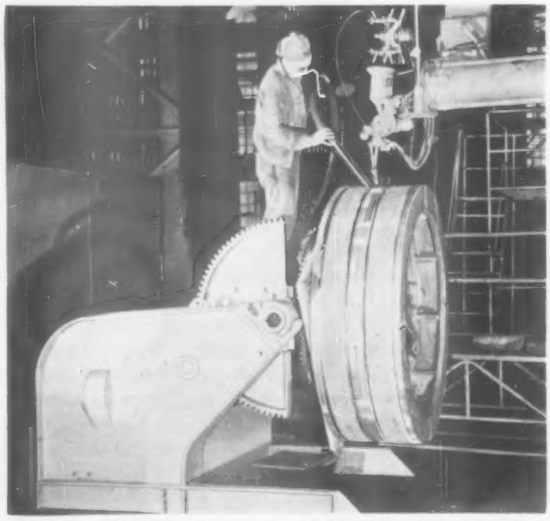


FIG. 9—With a table rotation of 360 deg, this positioner permits a complete circumferential submerged-arc weld.

—Photos courtesy Nelson Stud Welding

MACHINE welds studs to rear axle tube of Nash automobile. Operation is automatic, and air cylinder clamps tube in place. Chute carries away broken ferrules.

Auto manufacturer finds:

Stud welds merit new applications

A STUD-WELDING innovation, originally used to improve design and speed the assembly of Nash automobiles, is now marking its sixth year as an integral part of the running-gear assembly of both Nash and Hudson autos.

Early in 1950, for the first time in the automotive industry, Nash manufacturers employed a ¾-in. shoulder stud as an anchor pin for the shock absorber at the axle end of their "Rambler" model. The stud is a horizontal extension of the shock absorber plate, which holds the leaf spring to the axle by means of two U-bolts placed over the axle.

The severe shearing forces which the stud would have to withstand were known, and the manufacturers were understandably surprised to find that this welding application provided 100% dependability.

Redesigned Assembly

Engineers at American Motors Corp., Kenosha, Wis., manufacturers of both Nash and Hudson automobiles, have now redesigned the running-gear assembly of all 1956 production models to incorporate two additional key functions for the studs.

In one application, two standard, ¾-in. shoulder studs are welded to the rear axle tube. One stud becomes a truss-rod anchor, while the other holds a bracket which secures the sway bar.

Only the truss-rod stud is used on the opposite end of the axle, and the sway bar is attached there to the car body. Before the redesign using studs, a forging hand-welded to the axle tube fastened the truss rod.

Approximately 4 in. of hand welding was required to fasten this forging, which also had to be faced-off, drilled and tapped. A bolt was then passed through the hole in the truss rod and threaded into the forging.

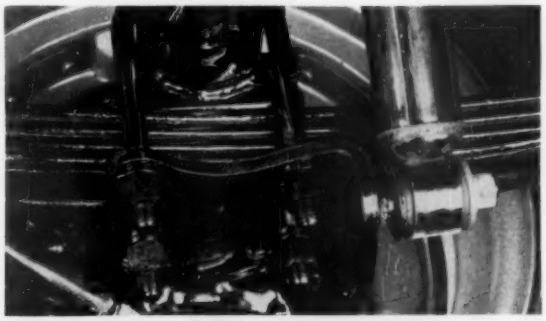
Eliminated Work

Forging, machining and hand welding are all eliminated with the use of the stud-welding process. Single-gun production units with accurate locating fixtures are used to weld the studs for all three applications.

When the welding cycle is started, a gun moves automatically into position, welds the stud and retracts. A chute attached to the operator's table carries away broken ferrules.

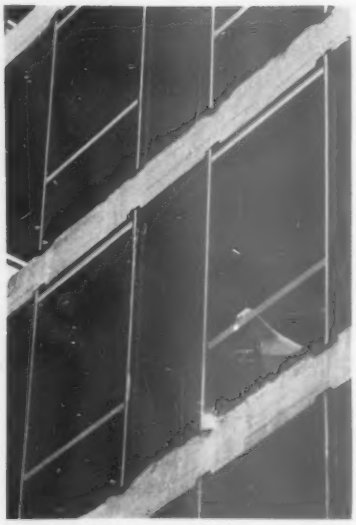
In addition to these stud-welding applications, the process is used also on seat slides for all Nash and Hudson autos.

CLOSEUP shows how ¾-in. stud is welded to shock absorber plate. Washer pressed against shoulder provides a bearing for shock absorber slipped over stud.



STUD serving as anchor pin for shock absorber (right) receives severe shock when car hits a bump. Application proved 100% dependability of studs.

"Sky-high" welding on stainless-clad N.Y. office building



ABOVE: Weldor attaches mullion to angle iron previously welded to building's primary steel structure.

BELOW: With its stainless steel outer wall fitted to the 42nd floor, Socony Mobile Building towers above buildings in background.

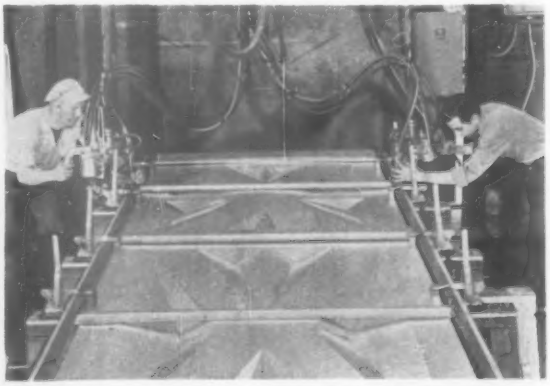
OCCUPYING the better part of a New York city block and towering 45 stories above 42nd St. between Lexington and Third Avenues, the stainless steel-clad Socony Mobil Building represents a major triumph in modern architecture and engineering.

In this victory over the *status quo* in building construction, welding was called upon to provide those unique advantages of strength, speed, neatness and light weight without which the world's tallest stainless skyscraper could not have been so quickly and economically erected.

A brick exterior was originally planned for the building, now in the final stages of interior finishing. Plans were changed, however, and 20-gage Type 302 stainless steel was used as an outer wall on every floor above the fourth story. The first four stories are covered with a combination of colored structural glass and stainless.

Choice of a fabricator who had the equipment and know-how to handle stainless sheets up to 50 sq ft in area finally centered on Commercal Shearing and Stamping Co. of Youngstown, Ohio. Working in close harmony with associated architects Harrison and Abramovitz and John B.

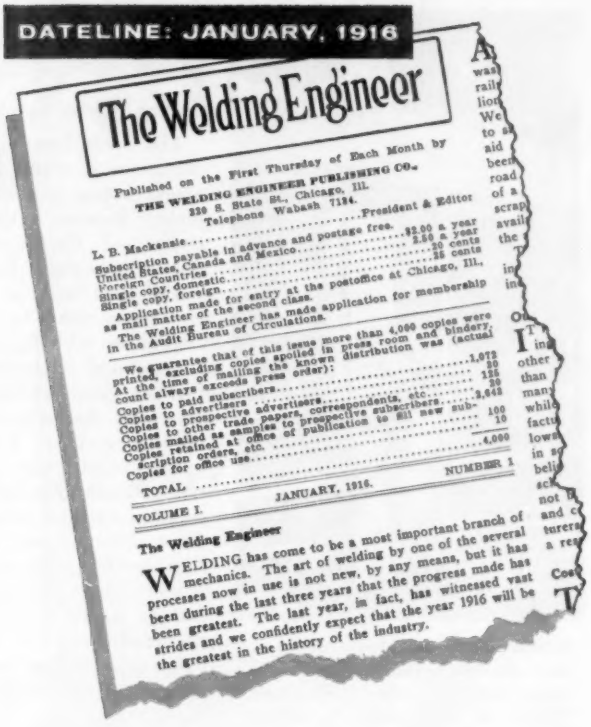
TIG welded patch-plates cover slits made in panel corners for forming operation. This is a window panel.



Z-BAR stiffeners are spot welded to back of patterned stainless panel. These braces also served as points of attachment to secondary steel framework.

AIRCO SALUTES WELDING ENGINEER

DATELINE: JANUARY, 1916



The Welding Engineer

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VOLUME I. JANUARY, 1916. NUMBER 1

The Welding Engineer

WELDING has come to be a most important branch of mechanics. The art of welding by one of the several processes now in use is not new, by any means, but it has been during the last three years that the progress made has been greatest. The last year, in fact, has witnessed vast strides and we confidently expect that the year 1916 will be the greatest in the history of the industry.

Your fortieth birthday is a milestone of which you may well be proud.

It is a milestone of particular meaning to Air Reduction, as we too, are now entering our forty-first year of service to the welding industry.

One of the first Air Reduction advertisements as it appeared in the early days of the welding industry.

These have been good years for all of us connected with the welding industry. We have seen it grow and prosper through the improvements of tools and processes and dissemination of information to the point where welding now touches almost every industry in some phase or practice.

The future, too, is bright with promise. These excerpts from recently published comments by Mr. J. H. Humberstone, President of the American Welding Society and President of the Air Reduction Sales Company, give emphasis to the challenge of the future.

"All of us connected with the welding industry have the greatest expectations as to its future. Not only is welding today an 'arrived' tool of industry—but it is on the threshold of performing even greater service. As witness—the continuing developments in machine welding, contour welding, the ever increasing expansion in the use of the inert gas processes, the improvement in welding machines and the emergence of brazing as a high production tool through the further development of furnace brazing and dip brazing. In cutting operations, of course we should not overlook famous electronic controls that have improved shape cutting so appreciably.

"Hardly a month goes by that we do not see a new or improved product or technique announced to add to the tools of our trade and the expertness of our craftsmen.

"How can we help but conclude that the next 10 years will bring us along with even greater strides in this 'golden age' of welding."

welding
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WORKER checks plumb of structural mullion before it is welded to angle iron on primary structure. Weldor on floor above is welding angles to primary steel.

Peterkin, Commercial designed over 500 different embossed panel patterns in an effort to find one which would preserve the characteristic crispness of stainless steel.

Triangular Panel Design

Settling finally for a *repousse* of triangular characters, the fabricators were satisfied that the panels were attractively symmetrical in design, easy to handle and, to a certain extent, self-cleaning.

Stainless steel plates that were annealed, pickled and lightly cold rolled for a moderately bright, uniform surface were packed in flat crates with paper between each sheet to prevent marring. The sheets were then cut to size (approximately 5 by 10 ft) with conventional shearing equipment.

The transformation from flat sheet to architectural panel was accomplished on a huge mechanical press. With a bed area of over 125 sq ft and a 2,000-ton pressure range, this press performed five separate operations with three sets of dies.

In view of the fact that the building had originally been designed for a masonry curtain wall, the bugaboo of odd dimensions was quite commonplace. Economical stamping operations were carried on, however, thanks to a versatile die design consisting of skeleton pyramids of welded steel.

High-Tension Forming

Flat areas between the triangular characters were kept flat by cast iron blocks bolted to the press bed and platen. Between ridges, the natural tension of the forming operation stretched the metal flat.

Two slits made at the corners of each sheet prior to stamping were later closed with Tig (tungsten inert-gas) welded patch-plates. It was felt that the argon-shielded Tig welds preserved the original strength of stainless steel.

The panels were given flexible strength with light, bent stainless stiffeners spot welded across their backs. These stiffeners were also a point of attachment to secondary steel.

Individually packed in corrugated cartons, again to prevent marring, the panels were then shipped to the building site, where they were bolted into place over welded studs on mullions.

Reputedly the largest commercial building ever to be completely air conditioned at the time of construction, the Socony Mobil Building boasts top-and-bottom cooling, heating and dehumidifying equipment that weighs 4,000 tons.

Oxacetylene Pipe Welds

The air conditioning system, manufactured and installed by Kerby Saunders, Inc., involved extensive use of welding and cutting equipment produced by a tenant-to-be, Air Reduction Co., Inc.

Four teams, with two men to a team, used portable oxyacetylene welding equipment to make approximately 100 joints on each of the building's 45 floors. Oxyacetylene cutting torches were employed to cut into riser pipes in preparation for welded joints.

USING oxyacetylene torch and a ⅛-in. mild steel rod, weldor joins ¾-in. branch pipe to 2-in. riser.

NEIGHBORING Chrysler Building towers above weldor and helper at work on frame of Socony Mobil Building.

Also among the notable "firsts" achieved by engineers on this newest of New York giants is a higher-voltage electrical system which cuts installation and power costs. Current is delivered directly and economically from a generating station at 69,000 volts, and stepped down just outside the skyscraper by six 2,000-kva transformers.

In addition to Socony Mobil Oil Co. and Air Reduction, other tenants who will occupy offices in the building early this year are: American Tobacco Co., First National City Bank, F. W. Woolworth Co., St. Regis Paper Co., International General Electric, American Iron and Steel Institute, Hill and Knowlton, Inc., and Turner Construction Co.

The firms that will headquarter in the Socony Mobil Building and the thousands of people who will enter the skyscraper for business will see only the outer facade and inner walls of this handsome addition to the New York scene.

But behind these panels are the welds and the welded metals which will give this skyscraper a strength and durability which could not have been obtained by any other metal joining process.

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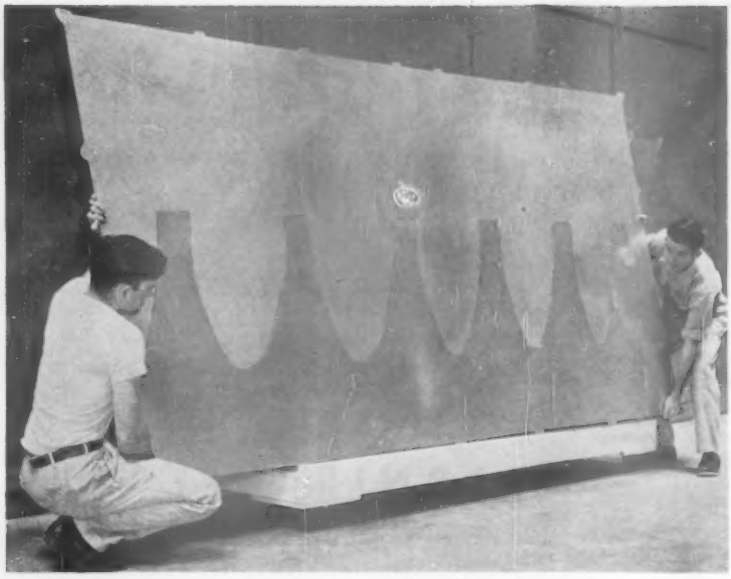

ADHESIVE bonding of doublers to wing skins provides weight saving and avoids stress concentration created by rivets. Structural strength is built in where stresses are greatest. *—Courtesy Narmco Inc.*

SINGLE-lap tension-shear test is made with a metal-to-metal adhesive bonded sandwich specimen.

Part I:

The how and why of adhesive bonding

BY SAMUEL N. MUCHNICK*

THE STRENGTH of an adhesive-bonded metal joint can approach the cohesive strength of the bonding agent if metal surfaces have been properly treated. By means of contact angle measurements against water, the adequacy of surface treatment can be determined.

The contact angle very conveniently and simply describes changes in surface properties of metal resulting from the treatment. Even more significantly, it can be used as a control in industrial applications.

A review of technical industrial literature on adhesive bonding of metals indicated that treatments for conditioning metal surfaces have been based primarily on empirical discoveries.

Although a number of effective treatments for specific metals are in use, no basic understanding of surface energy requirements for adequate bonding strengths is obvious in the selection of these surface treatments.

A study was made of the changes in surface properties of aluminum, stainless steel, magnesium and titanium treated with solvents and acid and alkaline solutions. These changes in surface properties are shown to be related to contact angles which water makes with these surfaces.

By this method, an acceptably effective surface treatment for aluminum was characterized, and became the basis for attacking problems of bonding stainless steel, magnesium, and titanium. During the course of the work, factors other than surface energies were found to influence joint strength.

Conditions for Bonding

We at Franklin Institute more or less established that free surface energies of most common plastic surfaces are less than those of water. Therefore, if water spreads on a treated metal surface, it is a reasonable certainty that adhesive film also will spread.

Pure metal surfaces not contaminated with adsorbed films result in drastically lowered free surface energies and reduced bonding energies. The role of the adsorbed film in bonding procedures, therefore, is a serious consideration.

Cleaning and etching treatments can only modify or replace the original adsorbed film and, because of the high free surface energy of the bare metal and the promiscuity of these attractive energies, the character of components of the surface treatment is important. One or more of these components will replace the original adsorbed film.

The surface and dimensions of adsorbed film affects wettability, binding strength and resistance to weathering. The metal, as received, normally has on its surface an adsorbed hydrophobic film or layer of varying thickness.

If this thickness is duplex (an ad-

*This article is an abstract of a paper given before a meeting of the American Society of Mechanical Engineers. Mr. Muchnick is associated with The Franklin Institute Laboratories, Philadelphia.

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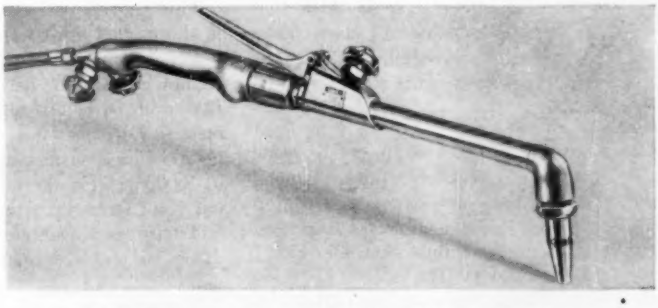
See for yourself how you can enjoy tomorrow's operating standards today with an OXWELD W-45 Blowpipe. Ask your LINDE representative for a demonstration, or write for free booklet, F-8684.



CW-45 Cutting Attachment adapts the W-45 Blowpipe for cutting steel up to 8 inches thick.

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sorbed film whose outer surface has surface properties of the bulk liquid) or greater, the metal surface has the properties of the bulk film.

Comparative Energies

It can be shown that these energies are relatively low compared with binding energies between the adhesive and a hard metal surface. If the adsorbed film is less than duplex, the surface properties of the metal are between that of pure metal and bulk film.

To bring an adhesive within the range of the strong attractive energies of the metal, it is necessary to reduce thickness of the adsorbed film or replace it with a different adsorbed film. This must also be less than duplex (like highly polar water), which apparently enables attractive energies between the surfaces to be fully exercised.

Nominal test results with a 1/16-in. standard bonded lap joint are not a true measure of the adhesive strength of the joint if an applied load deforms the metal. When metal is stressed, it is deformed elastically.

If stresses are great enough to exceed the metal's yield value, the material also will flow. As a result of the elastic and flow deformation, a single lap joint cannot be tested in pure shear except when metal panels comprising it are very thick.

Patterns of Failure

Depending upon thickness of the metal, strong adhesive lap-joints actually fail in four different ways:

(*a*) When the metal is thin, failure occurs by peeling. Strength of the joint under these conditions is a function of the metal's yield value, and is largely independent of the strength of the adhesive joint. This type of failure is observed with 1/16-in. aluminum panels.

(*b*) With thicker metal panels, the metal yields in tension with the failure starting at the edges of the adhesive joint. When metal at the edge of the joint stretches, the adhesive bond at the joint is broken, permitting the metal deeper in the joint to stretch. This process continues until the joint fails.

(*c*) If thickness of the metal is sufficiently large, it will not be stressed above its yield point and will only deform elastically. As a result of this deformation, metal panels become bowed and cause tensile stresses in the adhesive.

(*d*) When metal is so thick that tensile stresses caused by elastic bowing are relatively small, the joint fails in approximately pure shear.

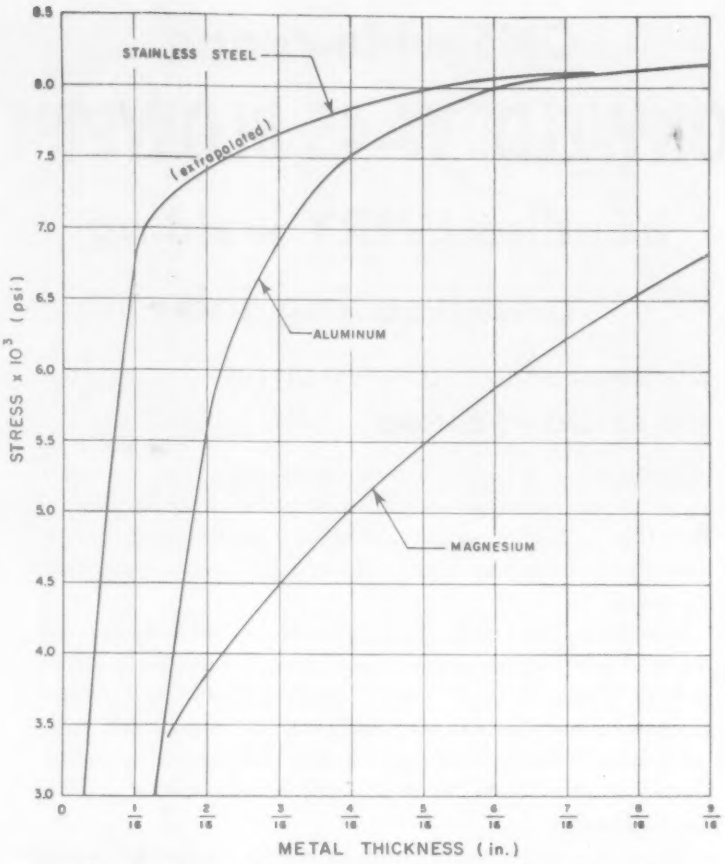


FIG. 1–Metal thickness vs. joint strength is plotted in chart. Slope of curves varies with metal thickness.

Plotting Joint Strength

When a series of joints is made using progressively thicker metal panels, and joint strengths are plotted as a function of metal thickness, curves such as those shown in Fig. 1 are obtained. The slope of these curves is not constant, but varies with metal thickness.

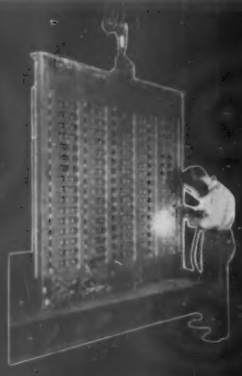
The curves themselves show that the four types of failure described above cannot be isolated from each other, but merge gradually as metal thickness is changed. For this reason, a rigorous mathematical treatment of joint strength in terms of metal thickness and mechanical properties is difficult, if not impossible.

Treatments developed for aluminum, magnesium and stainless steel appear to produce adhesive bonds as strong as the cohesive bonds of the adhesive material itself.

This analysis is important because it shows that for strong lap joints, nominal values using $^1/_{16}$-in. metal cannot be used for determining relative joint strengths among various metals. For instance, with 1/16-in. metal and a limiting cohesive strength of 8,000 psi for the adhesive, nominal joint strength with aluminum is 5,000 psi; with stainless steel about 7,000 psi, and with magnesium, 4,000 psi.

Yet, strength of the adhesive bond in each case is equal to or greater than cohesive strength of the adhesive. The single-lap test can, however, be used to show relative strength of joints with any one metal using different methods of surface treatment.

Look for the conclusion of this interesting study on the strength and applications of adhesive metal bonds in a future issue of WELDING ENGINEER.



WELDING SOLVES ANOTHER WEIGHT PROBLEM

(and USS "T-1" Steel solves the welding problem!)

Bedplates for modern color-printing presses have to be rugged—but as lightweight as possible. They must withstand constant pounding from printing rollers and cutting knives. And, since they move back and forth continually, they've got to be lightweight for fast, efficient operation. It is a good place to use a welded assembly of steel plate.

But that's where Graver Tank & Manufacturing Co., Inc., ran head-on into a tough fabrication problem. Alloy steel with the necessary strength and durability was difficult to weld. And with 534 welds to make on *every* bedplate, this was a king-size headache.

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Now the headache is gone. Production costs are down. And the finished bedplates are working hard and long . . . taking a tremendous daily pounding without distortion.

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HOW ABOUT YOU?

If you have tough jobs, rugged jobs, where you want to weld your way to lower costs, give this new steel a try. We think you, like Mr. McDonald, will find it the best thing you have ever used. Right now, "T-1" is in service and doing well in bridges, power shovels, steam turbines, electrical transformer tanks, flywheels, pressure vessels, mine cars, and lots of other places. Write for details. United States Steel, Room 5086, Pittsburgh 30, Pa.

"TOP QUALITY" That's how Graver Tank & Manufacturing Co., Inc., East Chicago, Indiana, describes new USS "T-1" Steel. It gives them a yield strength of 90,000 psi . . . exceptional resistance to impact abuse . . . and good weldability. It enables them to build extremely rugged, all-welded bedplates for printing presses.

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USS "T1" CONSTRUCTIONAL ALLOY STEEL

6-15

UNITED STATES STEEL

LARGE pipe sections are stored at laboratory job site before work begins on testing installation.

In the Southwest:

Miles of piping are Tig welded

BY MORRIS P. ROSEN

NO MATTER what weather or altitude conditions are encountered by equipment produced for the Air Materiel Command, they can be no worse than conditions simulated in testing aircraft parts at the new, $5,000,000 AiResearch Mfg. Co. laboratory in Phoenix, Ariz.

Justifiably proud of its role in setting up the test facility is the mechanical contracting concern of J. H. Welsh & Son. This firm welded together a stainless steel piping network considered by some to be the largest in the nation.

Laying miles of pipe, however, was merely one part of the installation called for in the almost $2,000,000 contract completed by Welsh.

Other phases included instrumentation and equipment; refrigeration; plumbing; fire protection system; excavation, trenching and backfilling for a utilities system; water and gas lines; sanitary sewers; industrial waste disposal, and insulation for piping and equipment.

40,000 Ft of Tubing

Indicative of the magnitude of the piping job is the estimate of J. J. Vargo, superintendent of Welsh's mechanical contracting division, that about 40,000 ft of small copper tubing had to be hooked up to central control booms used in testing aircraft units.

In each of the 28 cells used for checking jet components there were two such control booms. Each boom was capable of testing one unit. For each unit under test, therefore, almost 1,000 ft of small copper tubing was used.

Welsh also installed all associated piping necessary for control of units under test. Since each unit had to be subjected to conditions actually existing in an aircraft, one of the more difficult requirements was to assure a reliable supply of compressed air at 300 lb pressure and a temperature of 900 F.

Such high pressure and temperature standards ruled out the use of ordinary piping, and required a stainless steel installation. Some pipes were as large as 24 in. in diameter, and one elbow for a 24-in. pipe alone listed at $2,300.

Stainless piping was favored because of its strength and resistance to corrosion. Another decisive factor was that it could withstand the 925 F temperatures expected at times.

Portable Shop

To fabricate all process pipe needed, the contractors erected a 30 by 70-ft portable fabrication shop at the job site. This shop maintained a regular crew of pipe industry workmen for threading, bending, welding and installing.

According to shop foreman Edward Dryzmala, the usual fabrication tables

VARYING sizes and types of pipes involved are evident in fabrication shop on job site. Weldors used Tig primarily and utilized materials on hand instead of waiting for custom-made parts.

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G-E Convertible welding ignitrons include:
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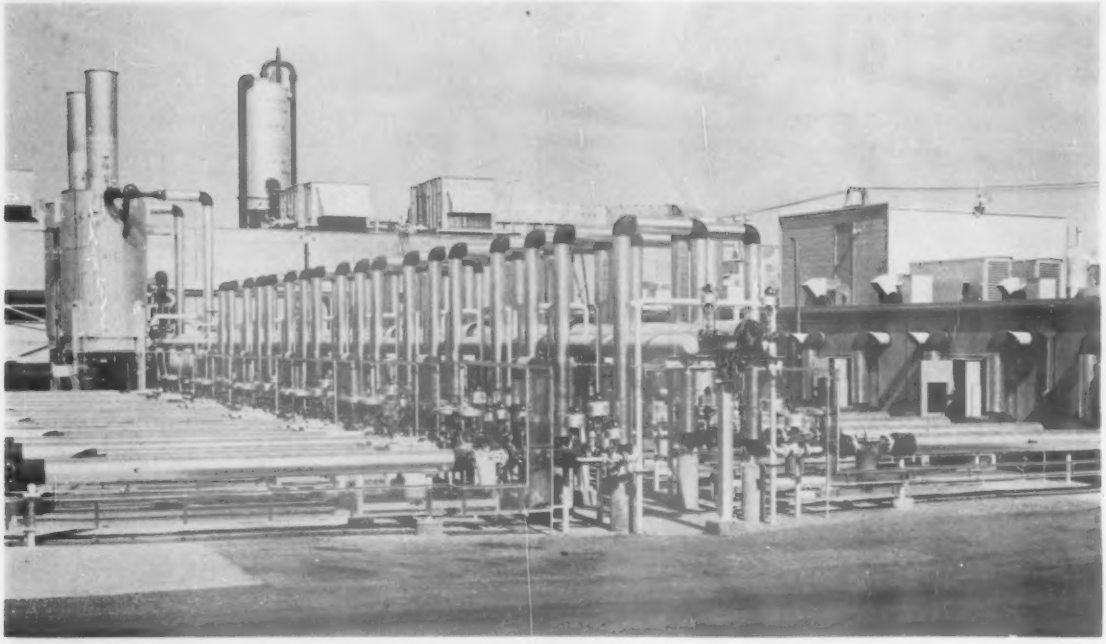


COMPLETED stainless pipe installation gives indication of job complexity. Giant heater at left increases molecular activity of compressed air before it is piped into test chambers.

were set up, and pipe jacks were used to level the pipe. Old, manually operated cutters were used to sever most of the pipe, thanks to the ingenuity of a workman.

This man machined a piece of tool steel, beveling it at 70 deg to facilitate the work.

"In this way," superintendent Vargo explained, "each cut on a pipe gave us two bevels for a weld. However, when working on lines over 10 in., we used a cutting torch with a carbon steel rod and beveled both ends with a portable grinder. Such beveling had to be done in order to allow for maximum strength and penetration of the weld."

Heat Expansion

In general, pipes to be fabricated ranged in size from ¼ in. to 24 in., although most of them were in the 3 and 8-in. categories. Bellow-type expansion joints had to be used, supplemented by cold springs.

When the line warmed up, drops and risers leading from the header line became plumb. High temperatures can cause stainless steel to expand as much as ¾ in. per hundred linear feet.

Very rigid welding requirements were necessary in fabricating the network of stainless steel. The Tig (tungsten inert-gas) process was prescribed for each joint.

Four Tig torches, with argon as the shielding gas, were needed for this phase. To avoid oxidation and bleed-through, weldors used an argon gas back-up (purge) for all lines being welded.

"Tig welding for such a complicated industrial set-up was comparatively new in our part of the country," the shop foreman said. "We had to start from scratch in more ways than one, because the problems we faced were strange to most of the welding concerns in the area."

Weldors used rod sizes ranging from 3/32 to 3/16-in. Size, naturally, depended upon the particular application. Type 304 stainless steel wires proved most adaptable to welding requirements.

Preventing Delays

For pipe alignment, the fabrication crew used standard line-up clamps and V-blocks. General policy at the job site was to work with material on hand when unforeseen developments arose. This prevented long waits for special parts, and effected a measurable economy in time and money.

All tees, for example, were made by the workmen. They were branch-saddled into headers and reinforced with pads of carbon steel to support the branches. However, hundreds of factory-made stainless steel elbows and flanges, anticipated for the job, were carried in stock at the job site.

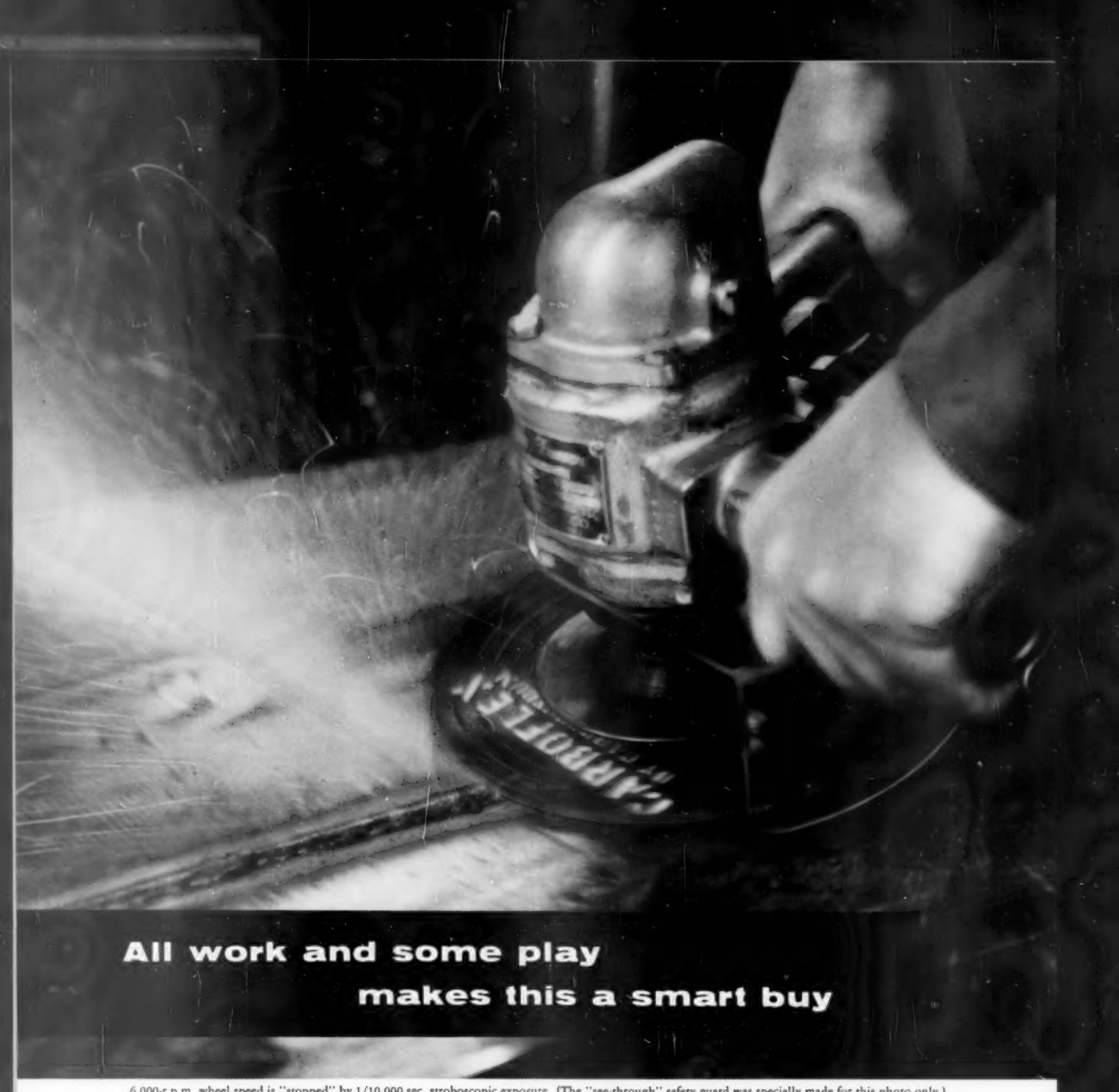
Weld Testing

Although no gamma ray weld inspection was carried out, coupons were cut and given tensile strength, as well as root and face bend tests for added insurance.

Fabrication, begun in the fall of 1954, was completed earlier this year. Before the facility was turned over to AiResearch for activation, however, a successful operating test was run at 500 lb pressure, much higher than the 300 lb specified by AiResearch.

John H. Welsh Jr., president of the contracting firm, points with pride to the manner in which his employees worked as a team to solve problems arising from this complicated piping installation and from the use of a welding process new to them.

"To come up to contractual specifications," he stated, "you've got to anticipate wherever you can, improvising and adapting as you go along. In the long run, a combination of know-how, alertness and ingenuity will pay off."



All work and some play makes this a smart buy

6,000-r.p.m. wheel speed is "stopped" by 1/10,000 sec. stroboscopic exposure. (The "see-through" safety guard was specially made for this photo only.)

Here's the perfect answer to all rough grinding problems. CARBOFLEX Depressed Center Wheels, with resilient fibre-reinforced construction, combine maximum cutting ability with maximum operator safety. Reduce or undercut heavy welds, clean up castings, rough off fins and sharp risers...in record time, at less abrasive cost per wheel. CARBOFLEX Wheels are tops for cutting-off and slotting, too! Another outstanding feature: the back of the wheel, like its face, is knurled. You can cut with either side, plus the edge... without initial dressing. Call your CARBORUNDUM Distributor or salesman today for a demonstration of this rugged production booster. For descriptive folder A-1272, write The Carborundum Company, Niagara Falls, New York. In Canada: Canadian Carborundum Co., Ltd., Niagara Falls, Ontario.

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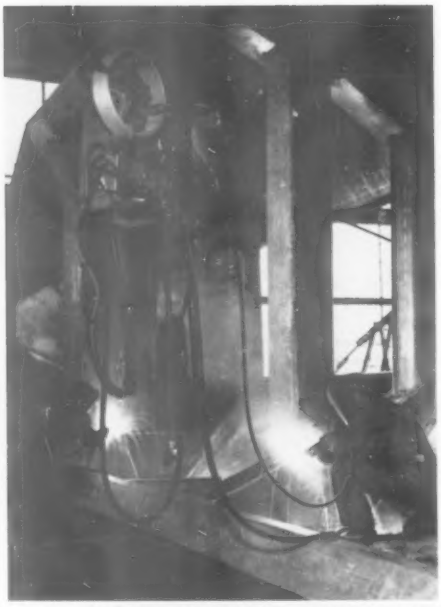
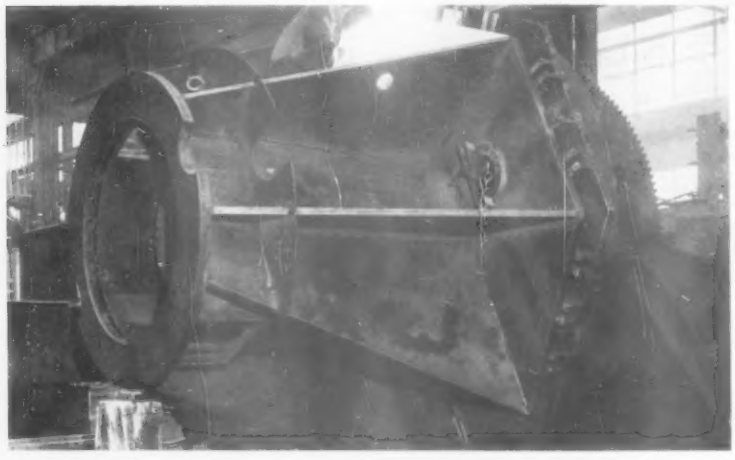
continually puts more sense in your abrasive dollar

on the job

—*Linde Air Products Co.*

RIGHT: Weldors use Mig (metal inert-gas) process to fabricate aluminum hoppers for drop-bottom trailer truck (above). Bolts holding draw bar to hopper are sole mechanical fasteners.





AUTOMATIC submerged-arc welds played a big part in the fabrication of this main frame for a special processing machine. The Falk Corp., Milwaukee, handled composite cast steel and welded construction of 33,000-lb frame.

—*The Taylor-Winfield Corp.*

FABRICATING plane parts since 1942, this resistance welder has never had a major breakdown.

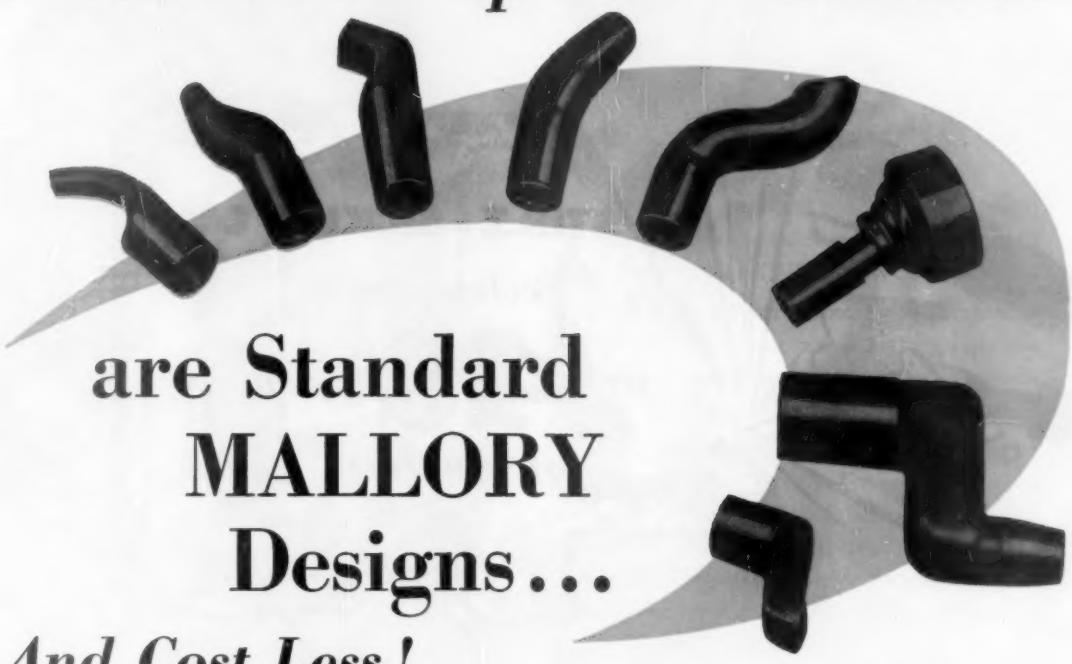
—*North American Philips Co., Inc.*

UP TO 3,000 welds a week are inspected with this X-ray unit at Delta Tank Mfg. Co., Baton Rouge, La. Unit uses high-current tube operating at constant potentials up to 150 KV and currents up to 20 milli-amps.

—*Pandjiris Weldment Co.*

RUBBER-tired, variable-speed turning rolls aided welded fabrication of this 90-ton cement kiln, 11 ft in diameter and 78 ft long. Automatic submerged arc process was used on all seam and butt welds.

Hundreds of "*Special*" Electrodes



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We look at it with some pride—pardonable, we hope—and with a determination to continue to lead the way with the best products in our chosen field: steel for the reclamation welding of parts worn by impact and abrasion.

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. . . when you can make difficult precision welds with robot-like regularity. But that's exactly what the LEWIS "Universal" can do.

Whether used for volume production or custom jobs, this automatic fixture cuts the time, sweat and high costs normally associated with large weldments.

The "Universal" is portable . . . permits simultaneous 3-directional operation . . . has an adjustable base for quicker positioning of heavy weldments. In addition, any standard head can be installed for welding, flame cutting or hardening. Dual heads can be used to make parallel welds.

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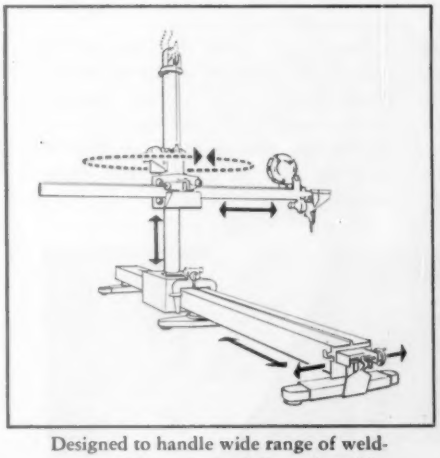
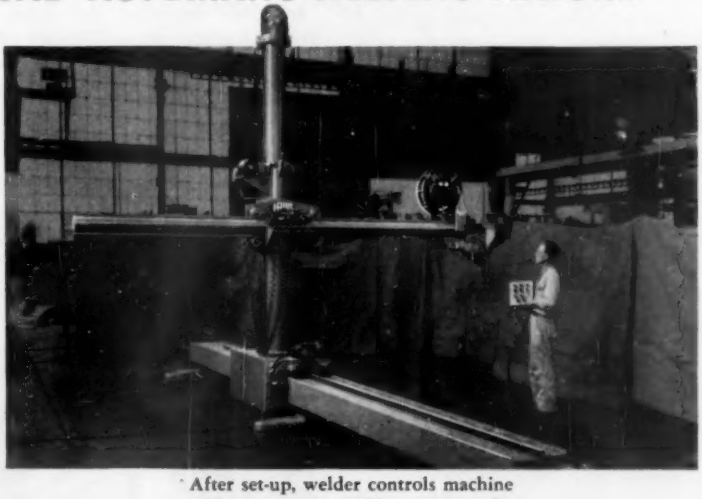


Designed to handle wide range of weldments, this unit is fully adjustable.



After set-up, welder controls machine with a remote pushbutton console.

LEWIS

THE LEWIS WELDING & ENGINEERING CORP.

77 Interstate Street • Bedford, Ohio

6712-LW

Shop-welded hardfacing lathe

HARDFACING lathe is installed outdoors and can be taken down for moving or storage. Total cost without motor, starter and variator was $300.

BY LLOYD McWILLIAMS*

ANOTHER in that long list of now-indispensable machines that were born only of urgent necessity is a hardfacing lathe completely fabricated by welding, except for those parts that necessarily had to be machined.

A few years ago, while overhauling three 45,000-hp turbines, the Shawinigan repair shop built up a naturally large backlog of welding and metallizing jobs.

Weldors were attempting to build up badly-pitted turbine runners with weld metal, and the rest of the shop was engaged in miscellaneous repairs on parts for a water-turbine.

The vanes or wicket gates for these turbines require a lathe with a 50-in. swing. Since a double-spindle lathe was the only available machine which could handle the vanes, the job of machining and hardfacing worn stems on the vanes placed a great strain on this lathe.

*Maintenance supervisor, The Shawinigan Water & Power Co., Shawinigan Falls, Quebec, Canada.

Outdoor Installation

The fact that the work had to be done indoors was an additional disagreeable factor. The spraying of metal is not conducive to cleanliness in any shop. For these reasons, the hardfacing lathe was developed.

Installed outdoors, the lathe is driven by a three-phase, 550-volt, 1½-hp motor which develops 870 rpm. A variator with a 9-to-1 ratio gives a speed range of 12 to 120 rpm on the work.

When not in use, the lathe can be dismantled and stored away. Since odds and ends from the scrap pile were garnered to construct this unit, the cost without motor, starter and variator was approximately $300.00.

Although they were not handled by the hardfacing lathe, the turbine runners had to be treated in a special manner. The erosive pitting had developed to a degree where a build-up with weld metal was impossible.

To effect a repair, sections of the least-pitted buckets were cut out. From these a pattern was made, and stainless steel inserts were cast.

The combination of casting and welding thus makes it possible to effect repairs quickly and at considerably less expense. It also saves time and money on finishing.

The inserts were then welded in place and ground to a smooth finish, conforming to the original contour of the buckets. To the best of our knowledge, this is the first time a complete turbine runner has been rebuilt in this manner.

TRAILING edges of a 45,000-hp turbine were badly pitted before welded repairs.

STAINLESS steel inserts have been cast and welded into place on turbine runners.

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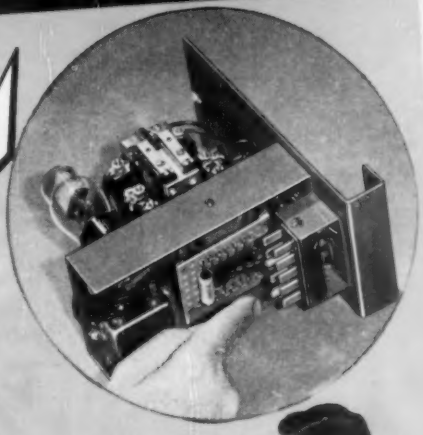
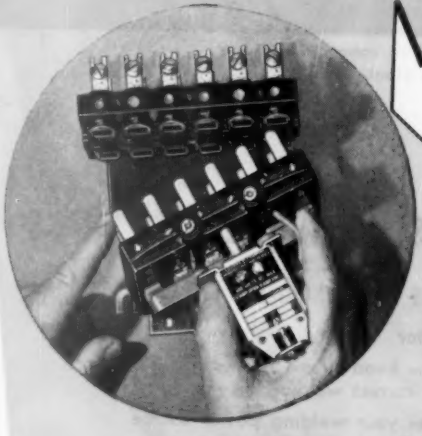
INDUSTRIAL *Plug-In* UNITS!

Welding Press Control illustrating simple removal of plug-in electronic timer



Plug-In TIMERS

are designed to stand up under hard industrial usage. Both timers and sequencing relays can be installed in a matter of seconds. Down time is reduced to absolute minimum during replacement. Timing circuits are fail-safe—if any tube fails to fire, circuit will be opened and welding process stopped instantly.



Plug-in relays being removed from welding press controller Faster electrical maintenance

Plug-In RELAYS

are of special rugged industrial design and construction. Flexibility provided by plug-in feature (on both sequencing relays and timers), permits easy circuit changes without complete controller redesign.

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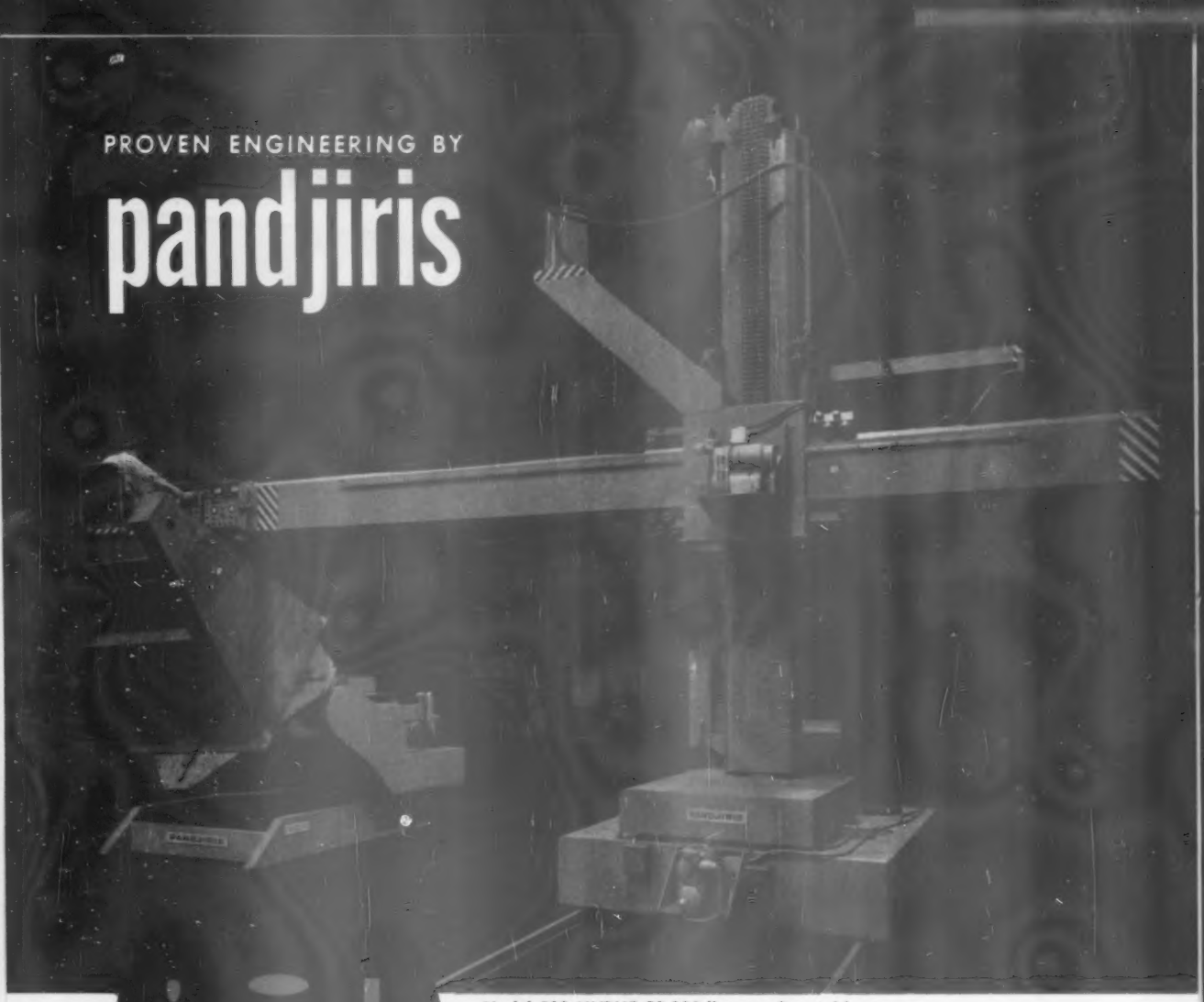

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efficient positioning of all three

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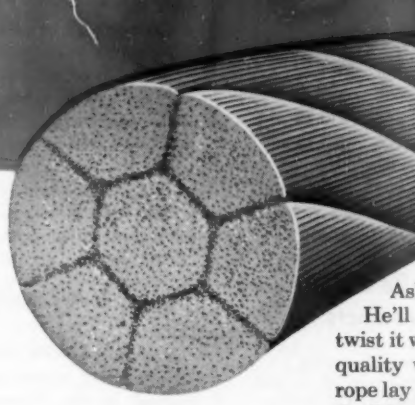

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LETTERS . . . . *from page 11*

pairs by fusion welding of boilers and other pressure vessels.

I am now in business for myself. I would appreciate any help you can give me.

Charles W. Kenna
Bridgeville, Pa.

—We are glad the articles we publish are of help. That is our aim and we hope we may continue to make them helpful. The test referred to is the Hartford test and is primarily a procedure test. In Pennsylvania there is also a state boiler code, the requirements of which must be met in welding. Mr. Kenna has been advised to contact the State Boiler Inspector at Harrisburg, Pa., as well as the Pittsburgh office of the Hartford Steam Boiler & Inspection Insurance Co.

* * *

Our error

Dear Sir:

On page 22 of your November issue the caption underneath the top picture contains some erroneous information. If you will check, I believe you will find that the operator is not feeding "aluminum wire into a form."

Jack Zidek
Midland Metal Products Co.

—We were wrong. The phrase should have read "aluminum-killed steel wire."

* * *

Arc welding

Dear Sir:

We noted with interest the article "Arc welding power sources" which appeared in the November WELDING ENGINEER, p. 23. We would like to have a tear sheet of this article.

J. F. Ewert, Jr.
KSM Products, Inc.

—A tear sheet of the article has been sent to Mr. Ewert.

* * *

Filler Metals

Dear Sir:

I have been reading your series of articles by Orville T. Barnett entitled "Filler metals for joining" and would appreciate tear sheets of the articles to date.

C. L. Hibert
Convair

—Tear sheets of this series have been forwarded to Mr. Hibert.

* * *

Cast-iron alloy

Dear Sir:

I am a student enrolled at Henry Ford Community College. I would like any information which you could supply about "Rezistan" cast-iron alloys. This was mentioned in the new products sec-

tion of your July, 1955, issue.

Robert Eberline
Dearborn, Mich.

—Mr. Eberline has been advised to write to the manufacturer of "Rezistan" alloys—Uniworld Research Corp. of America, Cleveland.

* * *

Why Thanksgiving?

Dear Sir:

After reading the editorial "Thanksgiving with reason" in the November issue, I contacted Station KRNT here in Des Moines, and suggested such a similar question be asked on the air.

The station did pose the above question, and a poll showed the following results: People take Thanksgiving for granted; it is just a day away from work. Only five persons were really thankful.

R. A. Fillion
Major Weldors

* * *

Welding water jackets

Dear Sir:

I have a welding problem and wonder whether you might help me. The results I have been getting from welding motor-block water jackets have not been satisfactory. I have tried several different types of electrodes and recommended procedures but, as yet, have been unable to get a good leakproof bond.

O. B. Lineau
Capital Welding Co.

* * *

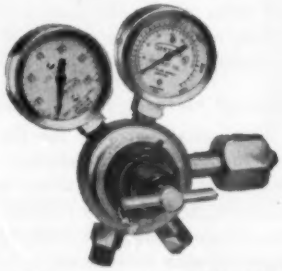
—The difficulty may arise from improper cleaning of the casting to be repaired. This is, of course, a difficult problem when trying to weld a motor block in place. A good steam cleaning using a grease-cutting detergent and perhaps acid cleaning afterward, followed by a straight steaming, might solve the problem. Leaks may be developing because of the presence in the weld zone of oil, grease or other foreign material. Some of this foreign matter may come from the water side of the cylinder wall. We would like to hear from readers about their experiences in this type of welding.

Fewer parts to wear gives you *Longer Life*

SMITH'S Econoflo Regulators

This is a new line of popular priced regulators which give you what you want in accurate trouble-free gas flow control. Functional parts have been reduced by 25%. That means fewer parts to wear, so you get longer life with less maintenance and upkeep costs. The seats are practically indestructible. They resist wear, heat, pressure and corrosion.

An inexpensive valve stem design eliminates need for delicate, costly nozzle. Special valve construction assures smooth, level flow at *all* times from full tank pressure down to empty. Day in and day out, Smith's Econoflo Regulators give you service you'd expect only from regulators costing twice as much. Ask us for full details.



Functional parts reduced by 25%

That means less wear, less maintenance, less time to adjust and operate. These Regulators are built to stay on the job. They let you forget about regulation and concentrate on your work. Special sintered bronze filter protects mechanism against wear from dirt and dust.

New seat stands high temperatures

You can say goodbye to delays from burned out seats. New seat material used in Smith's Econoflo Regulators will withstand temperatures that ignite ordinary seat materials. And, they are impervious to gas and acid reactions.

Full information on request — mail coupon

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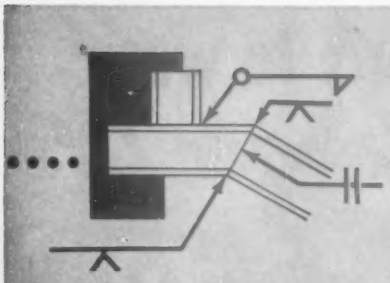


the welding clinic

Here you may find the solution to your welding problems, whether they concern design, production, construction or maintenance welding. Submit your questions for answering on this page.

Before welding a tank—be sure it's clean!

Question:

Is it possible to arc weld safely the front suspension spindle supports on Ford and Mercury automobiles produced from 1949 through 1953?

Answer:

The spindle supports for these auto models were made of SAE 5132 hot-forged, heat-treated steel. This steel has a medium carbon and chromium content which could easily develop cracks during welding. Likewise, any welding would destroy the qualities obtained by the original heat treatment.

Replacements for broken spindle supports are readily available at any Ford and Mercury agency for only a few dollars. Therefore, any small saving which could be realized by salvaging worn parts would be more than offset by the hazard of failure in this vital component.

Question:

What economical methods can be used by a small welding shop to clean tanks that formerly contained flammable or explosive materials for a welding operation? We have been running the exhaust from a gasoline engine through these tanks, and have kept up the flow during welding. Is this safe, or is there a better method?

Answer:

Flammable and explosive substances may be present in a container if it has held gasoline, light oil or other volatile liquids that release potentially hazardous vapors at atmospheric pressure; an acid that reacts with metals to produce hydrogen; a non-volatile oil or solid that will release hazardous vapors if the container is exposed to heat, or a combustible solid, finely divided particles of which may still be present in the form of an explosive cloud.

If you know what substance the container previously held, but don't know whether it's combustible or not, consult a chemistry textbook before welding. Combustible solids, liquids or gases are either soluble or insoluble in water. Again, a chemistry text will come in handy for this determination.

If you don't know what the container previously held, play it safe. Assume the material was flammable and not soluble in water. A soluble substance can be flushed out with several water rinses. The danger of non-soluble materials can never be fully eliminated in this way.

Easiest Method

Water cleaning is by far the simplest method if it has definitely been determined that the container held a substance that is water-soluble. Acetone, alcohol and some acids are examples of such substances.

For gasoline or oil tanks, a hot chemical solution is necessary. Seal the tank completely except for the filling vent and drain. Flush it first with water, then dissolve a compound of sodium silicate or trisodium phosphate in a little hot water. Pour this into the container, fill it with water (two to four ounces of the compound per gallon of water constitute a proper ratio), and use steam to maintain a temperature of 170 to 190 F for 15 to 20 minutes or more.

Drain the container and inspect it with mirror and flashlight. If sludge remains, repeat the process.

When steam cleaning, make an initial rinse with a solution of hot soda or soda ash (1 lb of chemical to a gallon of water). Fill the container at least 25% full with this solution and agitate to cover all inside surfaces. Drain the container and seal it completely except for a drain and a filling connection or vent.

Ground Metal Parts

Using a hose no bigger than ¾ in. in diameter and low-pressure steam, make connection with the container and blow steam through the drain. Make sure the container is grounded, as well as the metal hose nozzle if there is one. If the container has only one opening, position it so that condensate drains from this opening.

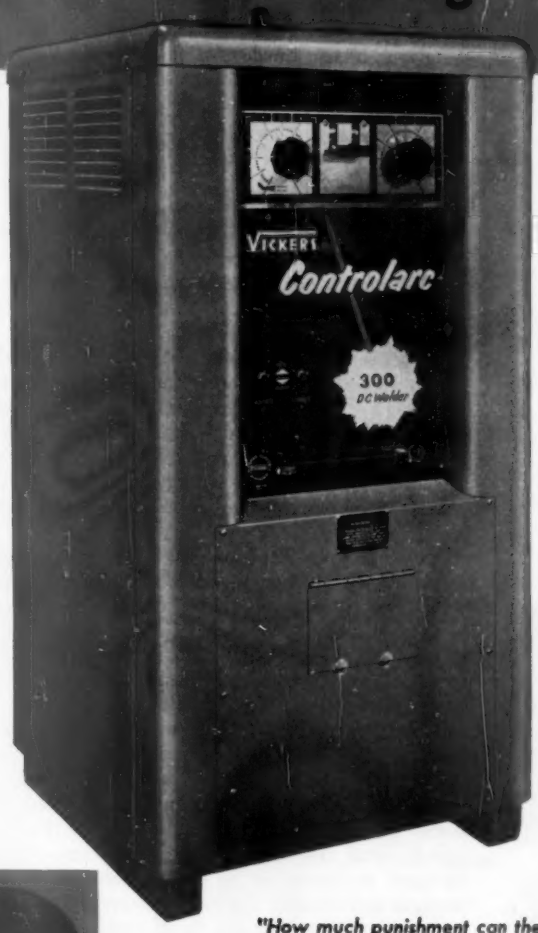
Continue steaming until the steam flows freely from the outlet of the container, then flush the tank with boiling water. Drain and inspect with a mirror and electric lantern or flashlight, then seal tightly for 15 minutes and re-inspect the container with a combustible gas indicator or the Larner gas sampling apparatus.

This latter machine is described in the AWS Standard A6.0-52 pamphlet, "Safe practices for welding and cutting containers that have held combustibles."

This valuable booklet can be purchased for 50 cents from the American Welding Society, 33 W. 39th St., New York 18, N. Y.

Using a gasoline engine exhaust provides a limited safety factor, but it should never take the place of the cleaning methods described above. An inert gas and water can be put in the tank after cleaning and kept there during welding for additional safety.

VICKERS® Controlarc DC Arc Welder Survives Punishing "Durability Test"



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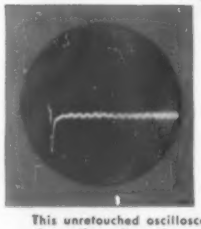

This unretouched oscilloscope photograph shows the voltage trace occurring when the arc was broken very quickly during the test, subjecting the CONTROLARC welder to severe abuse.

"How much punishment can the Vickers CONTROLARC DC Welder take?"

Vickers engineers decided to find out.

A 200-ampere CONTROLARC was subjected to a gruelling durability test. Every nine seconds the welder was charged with a six-second load of 250 amperes (50 amperes above rated capacity) at 27.5 volts. After 198,900 "makes" and "breaks" the load was boosted to 300 amperes at 27 volts. When the test was concluded the CONTROLARC had survived 1,004,522 of these charges, *and was still going strong*—with no apparent effect on any part of the welder. This test simulated arc tacking on production at 4 tacks continuously per minute on an 8-hour day basis for over two 300-day years.

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VICKERS ELECTRIC DIVISION

VICKERS Inc. a unit of Sperry Rand Corporation

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Where we stand . . . . . *from page 24*

There will be an increase in dollars spent for equipment and less dollars for accessories, because semi-automatic welding machines will replace electrode holders. There will be a new market for gases —a tremendous market. To visualize its size, it is necessary only to multiply 40 cu ft per hour times an eight hour day, times 22 working days a month, times 90% of all arc welders now in existence.

A. A Bernard, President
Bernard Welding Equipment Co.

CONGRATULATIONS to WELDING ENGINEER on surviving early trials and on capably pacing this dynamic industry of ours for 40 years. Starting a decade earlier, we at Fibre-Metal Products have seen this industry develop both in techniques and as a vitally substantial economic factor in our country.

Joining of metals is basic in all industry. Maintenance and repair by welding serves all industry. The business of welding has grown because it is economically sound . . . which means welding joins successfully and cheaper. As experience expands this knowledge that welding is both good and economical, it expands and develops new means and uses for welding.

Our experience has been the basis of our engineering, and I can see that as the economy of this country and the world expands to still greater heights, better means and materials will be developed. The welding industry as we know it now will be considered an infant! We have always been optimistic and it always pays off.

F. M. Bowers, Vice-President
Fibre-Metal Products Co.

MANY OF us can remember when the life expectancy of a male was about 45 years. He had to work like hell to make a living, and everything he did was harder than hell to do. I worked for a company which operated five open-hearth furnaces making steel castings, mainly for railway freight cars. Most of the castings were truck side-frames weighing about 500 lb.

Each casting had two risers 4 in. in diameter, necked down to about an inch in thickness close to the juncture with the casting. A very novel method of removing risers consisted of putting a 16-lb sledge in the hands of a brute of a man. He sledged that riser until it broke at the neck. The casting then passed on to the most cumbersome piece of equipment manipulated by two men to grind off stub ends of risers.

One day a chap came along with an acetylene generator, a tank of oxygen, a cutting torch and a welding torch. He said he was going to cut these risers off, so he got out his little "fire pistol" and we all stood around—ready to laugh in his face. Well, he lit it and got the darn thing set to cut close to the base casting to eliminate grinding, and then he put on the pressure and—ZIP—the riser toppled over.

After we were revived with the proper stiumlants, we bought the outfit. The little 50 lb acetylene generator, a cutting torch, a welding torch, and regulators (all German made) cost $1,500. This was in 1908!

Modern methods of joining and severing metals can take credit for lifting an awful load from the backs of working men. We have developed the processes for welding any existing metals, and as new metals or alloys are developed, the right welding procedure will quickly be determined by our laboratories.

C. E. Phillips, President
C. E. Phillips & Co.

ARC WELDING has done much to change our designing and manufacturing methods over the last 40 years. It has opened avenues for tremendous economies and has introduced unique methods very satisfying to those who use them.

Fifty years ago arc welding was done entirely with a washed electrode, which made deposits handicapped by elongation and variations in tensile strength. In 1928, the covered electrode became available in this country, and immediately eliminated variations in tensile strength and gave other characteristics equal to or better than the parent metal welded.

The high-pressure boiler, earth moving equipment, the Diesel locomotive and thousands of other products became commercially available because of welding. There were areas, however, where the economy of the new process would have been equally great had it not been rejected because of an engineer's hesitation. Steel buildings presently could be erected with a saving of at least 20% in steel costs. Bridges could be produced at a fraction of present cost with much greater utility.

Any commercially welded full-section joint, no matter how porous or undercut, is stronger than the parent metal. No riveted joint can, by any device, be made as strong as the parent metal. Tests for strength and ductility which are demanded for welding at the present time are, in all cases, tests which could not be fulfilled by any riveted joint.

Here is a great challenge for the welding industry. There is great progress to be made which is now delayed by benighted thinking. How can this progress be made? Will it be done by the present engineers or must we wait for funerals?

J. F. Lincoln, Chairman of the Board
The Lincoln Electric Co.

THEY SAY that life begins at forty. To call your first forty years "just a beginning" would hardly do justice to your accomplishments during that period. But, as you start your second forty, it is clear that the opportunity for growth and expansion of service to the industry was never brighter.

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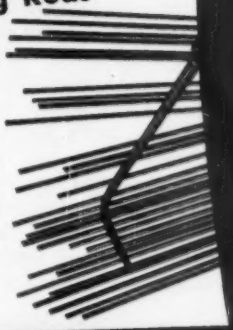

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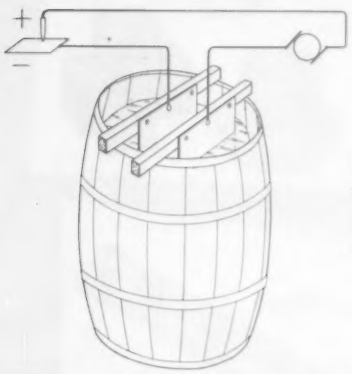
casional repair or maintenance operation to a commanding position among the production processes of American industry. I remember very well the conditions that prevailed when I first became familiar with arc welding. No matter what base metal was to be welded, and regardless of the geometry of the weldment, the weldor was expected to handle everything with one or two types of electrodes. If, as a consequence, some welds turned out less than perfect, he chalked it up to experience.

Then came the "hot rods," and with them the beginning of steady progress toward higher speeds, better quality and lower welding costs. Special formulations, coatings and procedures were introduced which enabled the weldor to tackle more and more difficult metal joining projects with assurance of success.

Further development of electrodes, welding equipment and procedures is inevitable. Automatic welding will find increasing use. With these improvements will come even greater utilization by industry of welding as a method of fabrication.

Merritt L. Smith, Executive Advisor
Metal & Thermit Corp.



1904

Barrel welder was an early carbon-arc power source.

Pictures courtesy Electric Arc, Inc., and Fibre-Metal Products Co.

INHERENTLY, both resistance welding and automatic arc welding are production processes. In a general sense, it is usually true that if there is no production, neither of these two processes are the way to fabricate metal. In the application of these processes, we are deeply convinced that a high degree of mechanization is here to stay. That overworked word, automation, which has achieved so much prominence in the last few years, is ancient history in the resistance welding field. Wherever there are quantities of items involved, these two processes have an extremely bright future.

As the aircraft industry, both military and commercial, moves further into the field of jet power, the advantages of resistance spot welding over riveting in primary structures moves into prominence.

In the past year or so there has been an appreciable upsurge in the application of resistance welding equipment to the hot upsetting or "resistance gathering" of metals. In the field of high quality flash welding, such as that done for aircraft landing gears and other military work, specifications have recently increased permissible design strength.

In the steel mill field, the highly competitive situation is causing new expansion programs to adapt flash and seam welding to a greater degree than ever previously used. In the electrical equipment field, there has been and is a continuing increase in the combination of forming, shearing and welding in joining terminals to the ends of small wires.

The expanding use of aluminum and its substitution for copper in certain fields is carrying with it an expansion in the flash welding and spot welding processes.

J. H. Cooper, Chief Sales Engineer
The Taylor-Winfield Corp.

IN THE welding world, seeds of thought grow and blossom and the fruit is a perfect product if fertilized with stress control. I predict that in a few years, all welded buildings will be made earth-quake proof by proper stress control.

All ships will be much more seaworthy and safe through proper stress control. All stresses will be placed against the load of service and all vital points will be placed under compression. All bridge repairs will be done first with the oxyacetylene torch, and replacement of parts will be made only when replacement is cheaper, a rare instance.

In the near future, careful investigations will be made and, from my observations, I predict that riveted joints will fail first. The joint welded under today's regulations will last three times as long and break in the weld area. The joint welded with all stresses controlled will last 30 times as long, and never break in or near the weld or heat affected area!

Joseph Holt
Snohomish, Washington

PRIOR to forming Miller Electric Manufacturing Co., I was associated with another company manufacturing motor generator sets and, in that manner, got my first taste of welding. I can well remember deciding that an a-c welder could be built that would perform a good job, and the people who told me I was crazy.

The first several hundred welders were produced in the basement of my home. I can still remember the aches and pains caused by hand cutting silicon steel laminations, hand winding coils, hand crimping cases, welding, and the effort exerted to carry the 350 to 400-lb finished product up the 14 steps from my basement to the driveway.

We have watched the inert-gas or tungsten-arc welding go from hand welding applications through automatic and into the consumable electrode types for welding. Now we see the same process being utilized for efficient cutting of non-ferrous metals. We have seen the development of a constant-potential power source for numerous types of welding and the end is not yet in sight.

While I do not have a crystal ball, I can see that automation is going to come more and more into the picture in the future. Hand welding processes, as we have known them in the past, should decrease

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considerably in production while automatic processes take over.

I can visualize a wider scope in the welding industry, and uses of welding in the future that are not now known. In my estimation, welding is one of the main pillars in our production economy and will increase yearly.

Niels C. Miller, President
Miller Electric Manufacturing Co.

IT SEEMS like a very short period in retrospect, but it has been close to 30 years since I became fascinated with the possibilities arc welding held for ship construction. Even then it was by no means a new process, but it was far from accepted, except as a means of attaching minor items and more frequently to patch up a bad rivet hole. A good-sized shipyard managed to get along with a couple of weldors and, periodically, some skeptical old timer hurt his toes trying to kick off a welded clip.

There are always those who feel that there are no new worlds to conquer. This view is no better founded than the attitude of the Chief of the Patent Office who resigned in the 1890's because there was nothing left to be invented. There are at least three good reasons to feel optimistic.

First: Just as the coated electrode was a milestone, so is the more recent inert-gas shielding. Bigger milestones lie ahead . *Second:* the field of metallurgy is constantly developing new alloys for higher temperatures, less weight, and greater strength under all operating conditions, and each poses a new and complex series of problems for the welding engineer. *Third:* we haven't really scratched the surface in the efficient use of design applications.

The young engineer who is starting out now has better tools to work with and a field limited only by his own ingenuity and imagination.

H. W. Pierce, President
New York Shipbuilding Corp.

BECAUSE you have been serving the industry for many more years than I have been associated with it, I cannot look into the past nearly so far as those who received earlier issues of WELDING ENGINEER. I can only look back to 1932 when I set out to earn my living as an electrode development engineer.

The past 25 years has seen welding come into its own as a real tool of industry. Many things accepted today as commonplace are possible only because we have highly developed cutting and welding processes. Even though gas consumption, electrode consumption and all other consumables associated with the various processes have increased many times in the past years, still greater increases are possible.

We know that not nearly as much welding is being done as could be done. This is because of the fact that not everyone has the opportunity that we in the industry have of seeing what is being done and what can be done. Not everyone has the confidence that we have in welding. Not everyone will have that degree of confidence until they know better the performance and potential of our various processes.

Your publication has played a great part and, I believe, will play a still greater part in spreading the gospel on the true merits of welding and cutting operations. It will play a big part as well in exposing the fallacies of faults occasionally laid at the door of these great fabrication processes.

With each passing day we see greater application of welding. We see it lend itself to mechanization to the extent that it is keeping abreast of the times. We see more and more modified processes developed to solve specific application problems.

I have no fears for the future. Welding will continue to grow, probably at a rate in excess of that which has prevailed over the past 25 years.

J. H. Humberstone, President
Air Reduction Sales Co.

THE WHEEL has been called the greatest invention in history. Although it was one of man's first inventions, it is still one of the most vital components in our manufacturing and production methods. As the wheel, the motor, the lathe, and the welding generator have improved, so has our factory production and our standard of living improved.

Efficiencies and ratings of welding machines have constantly improved during past years. Machines are run at high loads 24 hours a day with high performance and complete safety. All of these improvements have been afforded the manufacturer at lower over-all costs.

The electric arc has been controlled by various forces. Carbon dioxide alone has materially reduced the cost of certain automatic jobs. As research alters the combination of controlling elements, automation of the arc will improve.

Welding must look forward to a very bright future. It will play a vital role in the automatic factory of the future. As we join metals faster, and with more strength, we will all have more time to enjoy the products of our automation.

John Headapohl
Hobart Brothers Co.

THE FUTURE of welded ships depends chiefly on aggressive thinking and application. We cannot be too complacent in this new world. It is moving at a high rate of speed—a race between science, industrial achievement and time. Time will exhaust the supply of many materials that have been so important in molding our way of life for the past 200 years.

Those industries that will succeed in the future will not be complacent and depend on steel alone, but will expand in research and engineering and explore new fields. Shipbuilding and welded fabrication must take a place in this new endeavor.

The fusion of new metals will be the problem. Aluminum is being used on ships to some extent. It has excellent corrosive resistance in its pure state, but is not sufficient in strength. When alloyed, it has strength, but other qualities diminish. This alloy

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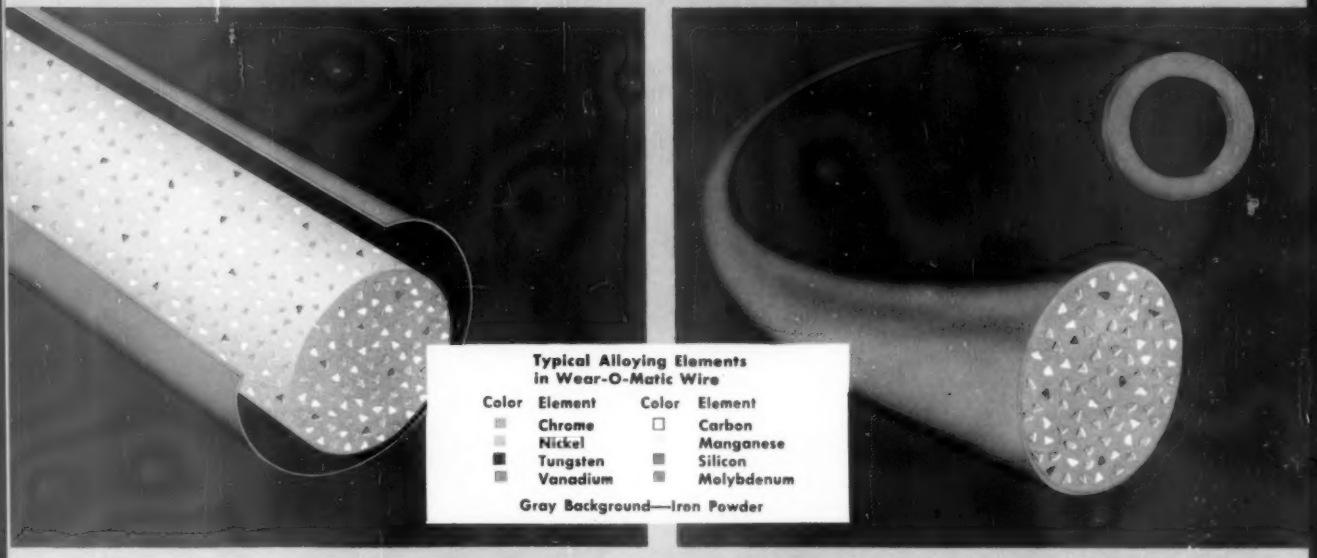

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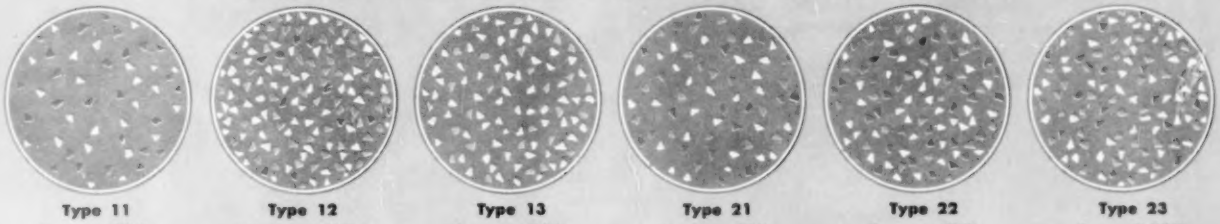

Type 11	Type 12	Type 13	Type 21	Type 22	Type 23
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Mn. 1.75%	Mn. 16.00%	Mn. 14.00%	Mn. 1.75%	Mn. .75%	Mn. 2.00%
Si. .75%	Si. .75%	Ni. 3.00%	Si. .75%	Si. .75%	Si. 1.50%
Mo. .75%	Cr. 16.00%		Cr. 4.00%	Cr. 4.50%	Cr. 15.00%
	Ni. 1.00%		Mo. .50%	Mo. 1.50%	
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Medium impact and high abrasion resistance.	WEAR-ARC 40 WEAR-FLAME 40	AC-DC or Acetylene
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Corrosion and heat in connection with abrasive wear.	WEAR-ARC & WEAR-FLAME A or B	AC-DC or Acetylene
Fabricated nickel manganese electrode for building up manganese parts.	MANG-ARC Bare or Coated	AC-DC Rev.

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could be used more extensively if we found a satisfactory procedure for welding, since expansion of aluminum is grater than steel. Undoubtedly, research engineers will find a solution for this problem in the near future by the introduction of a third metal or, perhaps, by a transition joint between steel and aluminum.

We should not allow practical science to lag behind basic science. Management must see that it does not happen. Industry is crying for men who can increase production, lower cost and, at the same time, produce a better product. There is an open field for men who can think and those who have the ability to get things done.

E. R. Hammett, Production Manager
The Ingalls Shipbuilding Corp.

IN 1922, when I picked up my first electrode holder and started apprenticeship as a weldor in a boiler shop, there was only bare and dust-covered welding rod and no slag removal problems. Weldors carried with them a wire scratch brush for cleaning welds.

During the change from bare to coated electrodes, no tools were offered the weldor for removing slag. One day in 1936, it occurred to me that I might combine a wire brush and chipping hammer and cut down the weldor's cleaning load by one tool. With an initial capital of $350, I bought a very small ad in WELDING ENGINEER. The very first order received came as a result of this advertising. Needless to say, it was a red letter day when that first Atlas *Dual-Tool* was shipped, and WELDING ENGINEER can take some credit for putting us in business.

Typical of the early problems encountered was a purchasing agent who didn't think his firm had any use for weld-cleaning tools because no requisition had reached his desk. By getting into the welding department and trying to convince weldors that homemade tools were more costly to make and less safe to use, we would sometimes get a trial order—and frequently a steady customer.

I also had trouble interesting welding-supply distributors at first. It was only logical that they wouldn't take on something they had no calls for, but the more aggressive distributors soon jumped in and gave a hand. The result: starting with one model, we now have 28. It was a long, hard battle, and we learned that no one person can grow without support from others.

Jack Honhart, President
Atlas Welding Accessories Co.

SINCE 1945, the variety of products assembled by brazing with silver filler metals has increased at least five-fold, while the consumption of silver filler metal has risen even more sharply. Practically every major class of assembled metal product contains at least several brazed joints or components.

Production brazing based on assembly-line technique, with semi-automatic or fully automatic heating equipment—employing combustion gases, induction and resistance heating—has substantially reduced production costs and increased joint quality. With automatic set-ups, one unskilled operator can turn out several hundred brazed joints of uniform strength and workmanship per hour.

Many assemblies, formerly machined from castings or solid metal, are now being fabricated from stampings, screw machine parts resulting in much lower labor and material costs. The trend toward automatic heating methods and the use of preforms can be expected to continue.

Paralleling the development of the new stainless steel and titanium alloys, silver filler metals have become available to fill stringent service requirements for improved strength and corrosion resistance at elevated temperatures. Virtually any known combination of ferrous and non-ferrous metals which have melting points above 1,150 F can be brazed, producing joint strengths of about 50,000 psi under most conditions.

A. M. Setapen, Engineering Manager
Handy & Harman

Repair welds in outer space

WHEN the day of space travel arrives, welding may often be called upon for emergency ship repairs in the airless void between planets.

In his newly published *Ark of Venus* (Alfred A. Knopf, Inc.) Clyde B. Clason visualizes what may prove to be a routine occurrence on interplanetary voyages two centuries hence. Mr. Clason was managing editor of WELDING ENGINEER for over 12 years.

Here is his interpretation of approved welding equipment for spaceships in the year 2135 A.D.:

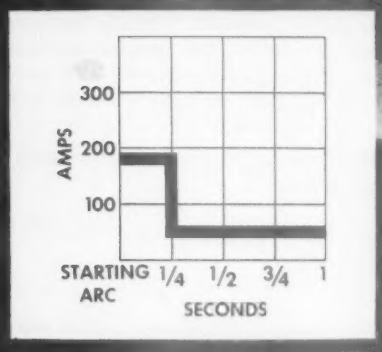
". . . Only a few days after that, a small meteor punctured the hull. A big meteor could have wrecked the ship; this one could not have been bigger than a grain of sand. Traveling at around 25 miles per second, however, it had enough kinetic energy to puncture both steel walls of the hull.

"The inner hole was so small they had to use a magnetic-flux leak detector to find it. After it was welded from inside the ship, they clamped on a midget-size radar transmitter to beam a signal so that the hole in the outer wall could easily be found.

"The weldor went out through the airlock in the "Bug," the only possible spacesuit for the vacuum of interplanetary space. The Bug was a steel carriage with a dome and a flat bottom.

"It traveled on magnetic rollers that prevented it from being accidentally dislodged from the ship. The operator sat inside, with regular air pressure around him, and looked out through a window. He put a green-glass shade over the window while welding.

"All of the controls for current, voltage and wire feed speed were inside the Bug, but the reel of welding wire and the feed mechanism were outside. Welding was very simply done in a vacuum because you didn't need to protect the molten metal from oxygen."



NO FALSE STARTING, no ragged weld beginnings with the G-E a-c welder's hot-start. Automatic G-E hot-start gives an extra boost of current for ¼ second . . . assures instant arc striking and extra penetration at the start of the weld.

FOR ALL YOUR WELDING NEEDS . . . .

A FULL LINE OF G-E WELDERS AND ELECTRODES

G.E. offers all popular forms of arc welders—plus a complete line of electrodes and accessories. This means that G.E. can recommend the equipment best for your job, without favoring any one type.

G-E MOTOR-GENERATOR WELDERS, are available in 200- and 300-amp sets. They feature a unique interactor, which practically eliminates popouts and voltage fluctuations.

NEW 200-AMP engine-drive welder, field-proven on construction and job-shop work, gives steady output, even above full load.

No False Starts . . . No "Popouts" With New G-E Line of AC Welders

Arc strikes instantly, stays steady—gives a sound weld from start to finish

Any professional weldor knows that better welds and easier welding begin with a good arc.

General Electric's new line of a-c transformer welders gives you this good arc—instant-striking and steady—plus many other features that make your welding faster, easier, and more economical.

1. NO FALSE STARTS. G-E automatic hot start provides that necessary extra surge of current which assures you of instant arc striking. Besides saving time, the hot-start furnishes extra penetration at the start of the weld—and reduces sticking.

2. ARCS ARE EASIER TO HANDLE, too. Popouts are practically eliminated because G.E. has made the normally stable a-c arc even more stable by the addition of special capacitors. These capacitors provide the equivalent of 5 additional open-circuit volts.

3. G.E.'s FINGER-TIP CONTROL gives you pinpoint accuracy of current with the moving-coil design. You don't have to "crank" the handle on a G-E welder to change current settings. It smoothly moves the primary coil on a finely-threaded, rubber-cushioned shaft—to give you stepless current control.

SEE FOR YOURSELF the operating advantages of the G-E a-c welder line. Ratings are available in 300-, 400-, and 500-amps . . . and 295 amps for general purpose welding. Just contact your nearby G-E Welding Distributor and ask for a demonstration. He's listed in the yellow pages of your phone book.

Progress Is Our Most Important Product

GENERAL ELECTRIC

A G-E EXCLUSIVE on the new 300- and 400-amp d-c rectifier welders is full-time arc-force control, which gives you a forceful, easy-to-handle arc.

GENERAL ELECTRIC'S LINE of electrodes is the most complete in industry. Special "balanced design" gives you a combination of: (1) Ease of use (2) X-ray quality (3) Welding speed.

FREE DESCRIPTIVE BULLETINS
Section A711-3 General Electric Company, Schenectady 5, New York.

Please send me the bulletins checked below:

- ☐ **GEA-6243 G-E AC Welders**
- ☐ **GEA-6242 G-E Rectifier Welders**
- ☐ **GEC-664 G-E MG Welders**
- ☐ **GEC-1333 G-E 200-amp Engine-drive Welder**
- ☐ **GED-2584 G-E Electrode Catalog**

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G.E.'S NEW ENGINE-DRIVE WELDER GIVES YOU . . .

Steady Welding Output—at Full Load; Improves Weld Quality, Costs Less Too

If you're using more than a 200-amp engine-drive welder for light to medium-heavy construction, you may be losing money. You may be paying for inefficiency—compensating for excessive loss of amperage and arc heat when operating at full load for sustained periods.

Now, with G.E.'s new 200-amp engine-drive welder, it's not necessary to buy more expensive, higher rated machines for pipeline, light construction, or job-shop work. This field-tested welder gives you steady output and 100% arc stability, hour-after-hour, even when operated *above* full load.

Test this powerful new welder yourself, and see the many advanced design features—new slow-down control, extra-rugged construction, and many others. Contact your nearby G-E Welding Distributor today. He's listed in the yellow pages of your phone book. Section 714-3, General Electric Co., Schenectady 5, New York.

EXTRA-STURDY construction is shown in this demonstration. Five nickels stand on edge while welder is operated at full load.

GENERAL ELECTRIC

When:

(a) two cast-iron platens of a 1,000-ton hydraulic press are badly cracked and broken;

(b) freight-car production is stopped as a result;

(c) the platen manufacturer can't produce replacements;

(d) outside welding shops quote an excessive repair price and cite a remote completion date;

(e) you're really behind the eight ball!—unless, of course, you plan to start . . .

PLATEN fractures were veed for braze-welding by chiseling and drilling. Part of this 40-ton segment has already received welded repairs.

Braze-welding by the ton

BY WILLIAM BOESE*

THE SITUATION outlined above presented itself recently at Pullman-Standard Mfg. Co.'s Michigan City plant where two 40-ton press platens broke down.

On first inspection, it was felt that the big platens could not be fixed. But when the manufacturer announced it could not replace the platens, and after job welding firms cited a very high price, Pullman-Standard decided to do its own reclamation job with the help and co-operation of its welding supplier.

The supplier provided necessary technical advice and assistance in the training of weldors and aided in supervision while work was in process.

Heavy Damage

Extent of the damage to the platens, which were made in 1914, seemed almost insurmountable. In the 42-ton top platen, the key-way slots were badly fractured and large side and end sections were crushed. Long cracks penetrated deep into the ends and the working surface.

The 40-ton lower platen was even more seriously damaged. It not only had numerous deep cracks and broken key-way slots, but it was broken in two parts down the center of its long dimension.

The task of repairing the castings fell into these stages:

(1) welding the main fractures;
(2) filling in crushed-out areas with steel plate and bronze welding rod, and
(3) applying reinforcing plates, blocks and bands to the backs, ends and sides.

Once the repair job was begun there was no let-up. Welding continued on a round-the-clock schedule for three weeks.

Method of Alignment

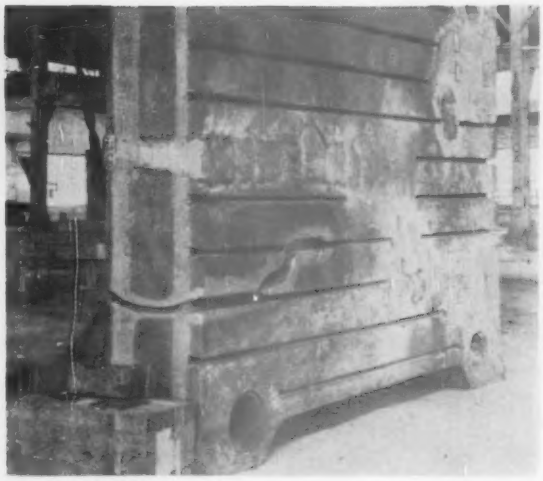
Edges of the breaks were veed for welding by drilling and chiseling, then cleaned of dirt, grease and rust by sandblasting.

Special handling was required for the lower platen, because it was in two pieces and had to be aligned for welding. This was done by placing the lower platen on top of the upper one with both faces in contact.

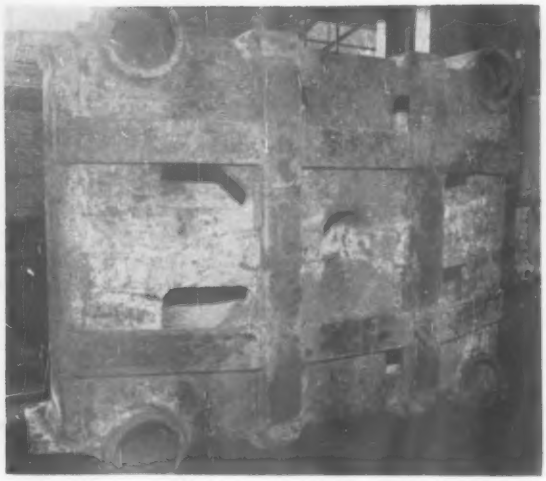
The lower platen was then supported and aligned by the upper platen. A special furnace was built of fire brick and asbestos to provide the

SPECIAL furnace aided preheat and prevented rapid cooling. Bricks and asbestos were easily removed for welding.

Chief welding engineer, Pullman-Standard Mfg. Co., Michigan City, Ind. Some of the information for this story was given by Linde Air Products Co.



CRUSHED areas were filled with steel plate and bronze welding rod. Key-way fractures were braze-welded only.



STEEL straps welded to platen backs gave strong reinforcement. Steel blocks added to sides anchored straps.

necessary temperature of approximately 500 F. These materials were so arranged that they could be partially removed to allow sufficient welding room.

When the sections were prepared and properly heated, two giant tack welds were made to bind broken segments of the lower platen together. Immediate reinforcement was made with steel plates.

This was followed by repair of half the push-out cylinder opening, and the application of center vertical welds for further reinforcement.

Final repairs to the lower platen consisted of welding the fractures in key-way slots, completing the push-out cylinder opening and applying additional reinforcing. The lower platen was completely repaired in 27 days, from initial preheating to the final weld.

Braze-Welded Areas

Although the upper platen was not as badly damaged as the lower one, it required special handling due to breaks in both sides and both ends. Beside a large number of breaks in key-way slots, there were many crushed areas to be filled in as well as several long fractures extending 6 to 8 ft into the ends and bottom.

After preheating, several welds were applied to one side of the casting. The casting was then turned over, and four large crushed areas were filled in with steel plate and bronze welding rod. A fractured key-way slot also was mended. Fractures in these slots were repaired solely by braze-welding.

32 Days of Welding

Final welds were made to key-way slots and steel bands and plates applied to reinforce the back and ends of the casting. The welding of the top platen was completed in 32 days.

Machining faces and other sections of the two castings, which took two weeks, was performed in the Chicago plant of Verson Allsteel Press Co. Careful examination of welds failed to reveal any flaws.

An indication of the size of the braze-welding job done on the platens may be derived from the following figures on material used:

20,839 lb of reinforcing plate;

11,000 lb of ¼-in. and ⅜-in. bronze rods;

150 lb of flux;

800 lb of electrodes;

304 cylinders of oxygen;

272 cylinders of acetylene;

22 tons of charcoal briquets.

It is significant that one of the oldest of welding processes, oxyacetylene braze-welding, was completely successful in economically repairing these much-needed press platens. They have been put back in service, and no failures have occurred in any of the welds.

COMPLETED platen is being machined prior to re-installation. Bronze deposits can readily be seen in repaired areas.

RETURNED to service, platens have shown no indication of weld failure. Used in both repair jobs was 11,000 lb of bronze rods.

See the heavy cast iron arm over the top of that whirling cylinder? When it and its support cracked, 1500 lbs. of semi-solid casting tore loose.

Cast iron arm snaps at 1200 RPM ...Ni-Rod "55" Repairs it in Jigtime

This centrifugal casting machine went on a fling 3½ years ago. It was whirling like a dervish when one of its rocker arms (see above and at right) cracked, snapped and flung the hot mold galley west.

The job to be done was ticketed "RUSH—U.S. Navy." On first inspection of the break it looked as though a 6-week delay was in the cards . . . to say nothing of $500 for new parts.

But there was a weldor at the plant who knew what Ni-Rod "55"* electrodes could do and how to use them.

He pre-heated the break with two torches to about 250°F. In welding, he followed standard procedure, using 5/32" electrodes at recommended amperages. The entire job took only 20 pounds of Ni-Rod "55" electrodes.

Two days later the rocker arm was ready for service. And today, 3½ years later, the casting machine is still on the job as you can see from these photos.

This repair is typical of the difficult cast iron welding jobs that are being done every day with Ni-Rod "55" and its companion electrode, Ni-Rod*. To get a better idea of the repairs you can make with these electrodes, write for our folder, "Repair Cast Iron Parts Quickly and Easily."

*Registered Trademark

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York 5, N.Y.

INCO
TRADE MARK

Ni-Rod "55" electrode had just been introduced 3½ years ago. Today most weldors depend on it for repairing cast iron.

The pointing finger, plus chalk marks, show where one break came. Chalk, because without it you could hardly see the weld repair.

This weld was made 3½ years ago with Ni-Rod "55" electrodes. Read how the weldor made $500 worth of repairs and saved six weeks down time, too.

NO SINGLE WELDER WILL DO IT ALL!

THERE'S EXACTLY
THE RIGHT **miller** WELDER
TO MEET EVERY WELDING REQUIREMENT

MILLER SR RECTIFIER TYPE DC ARC WELDERS

Available in 200, 300, 400 and 600 amperes, it is a superior direct current welder using Miller Unitran transformer control and selenium rectifiers for conversion from 3 phase AC line current. Miller SR Welders feature widest possible current range, extreme arc flexibility, maximum electrode deposition rate and highest electrical efficiency.

THE *New* MILLER SRH RECTIFIER TYPE DC ARC WELDER

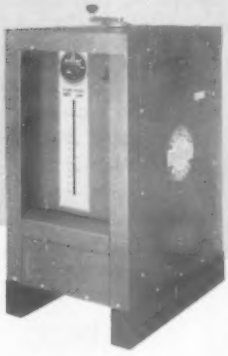
A new concept in welder design for all DC metalic arc welding. Available in 200, 300 and 400 amperes. It is ruggedly constructed, compact, and is designed to lend itself to stacking for parallel operation or to conserve floor space. It has single range control and is weatherproof.

MILLER ARC WELDERS FOR TUNGSTEN ARC WELDING PROCESS

These Miller Welders feature the patented Miller UNITRAN control circuit which combines the transformer with its own integral flux diverter. This, in conjunction with adequate open circuit voltage, high frequency, balancing resistor and optional controls insures superior uniformity and flexibility throughout the entire welding range. Available in nine models.

THE *New* MILLER MULTI ARC COMBINATION AC-DC WELDER

Available in 14 models, this new Miller Welder provides both AC and DC welding power for applications where both are required. It operates from a single phase power line and is available with high frequency and controls designed especially for inert gas arc and spot welding.



MILLER 100 SERIES HEAVY DUTY INDUSTRIAL TYPE AC WELDERS

Designed for heavy production welding and automatic welding applications. Available in eight models. The 100 Series Welders permit faster welding—as much as 35% faster. Movable coil design and 80 volts O.C.V. produces uniform and better welding characteristics throughout the entire range of the welder.

Write today for complete information on these Miller Welders.

ARC • SPOT miller GENERATORS WELDERS

miller

ELECTRIC MANUFACTURING CO., INC.
P.O. Box 798 Appleton, Wisconsin

"... if it's MILLER you know it's the finest..."

Circumferences and areas of circles

Diam. In.	Circum. In.	Area Sq. In.	Diam. In.	Circum. In.	Area Sq. In.	Diam. In.	Circum. In.	Area Sq. In.	Diam. In.	Circum. In.	Area Sq. In.	Diam. In.	Circum. In.	Area Sq. In.	Diam. In.	Circum. In.	Area Sq. In.
1/64	.04909	.00019	3 1/64	11.388	10.321	10 1/64	32.987	86.590	19 1/64	61.261	298.65	28 1/64	89.535	637.94	37 1/64	117.810	1104.5
1/32	.09818	.00077	3 1/32	11.585	10.680	10 1/32	33.379	88.664	19 1/32	61.654	302.49	28 1/32	89.928	643.55	37 1/32	118.202	1111.8
3/64	.14726	.00173	3 3/64	11.781	11.045	10 3/64	33.772	90.763	19 3/64	62.046	306.35	28 3/64	90.321	649.18	37 3/64	118.596	1119.2
1/16	.19635	.00307	3 1/16	11.977	11.416	10 1/16	34.165	92.886	19 1/16	62.439	310.24	28 1/16	90.713	654.84	37 1/16	118.988	1126.7
5/64	.29452	.00690	3 5/64	12.174	11.793												
1/32	.39270	.01227	3 1/32	12.370	12.177	11	34.558	95.033	20	62.832	314.16	29	91.106	660.52	38	119.381	1134.1
7/64	.49087	.01917				11 1/64	34.950	97.205	20 1/64	63.225	318.10	29 1/64	91.499	666.23	38 1/64	119.773	1141.0
1/16	.58905	.02761	4	12.566	12.566	11 1/32	35.343	99.402	20 1/32	63.617	322.06	29 1/32	91.892	671.96	38 1/32	120.166	1149.1
9/64	.68722	.03758	4 1/64	12.763	12.962	11 3/64	35.736	101.62	20 3/64	64.010	326.05	29 3/64	92.284	677.71	38 3/64	120.559	1156.6
			4 1/32	12.959	13.364	11 1/16	36.128	103.87	20 1/16	64.403	330.06	29 1/16	92.677	683.49	38 1/16	120.951	1164.2
1/8	.78540	.04909	4 3/64	13.155	13.772	11 5/64	36.521	106.14	20 5/64	64.795	334.10	29 5/64	93.070	689.30	38 5/64	121.344	1171.7
5/64	.88357	.06213	4 1/16	13.352	14.186	11 3/32	36.914	108.43	20 3/32	65.188	338.16	29 3/32	93.462	695.13	38 3/32	121.737	1179.3
3/32	.98175	.07670	4 5/64	13.548	14.607	11 7/64	37.306	110.75	20 7/64	65.581	342.25	29 7/64	93.855	700.98	38 7/64	122.129	1186.9
7/64	1.0799	.09281	4 3/32	13.744	15.033												
5/32	1.1781	.11045	4 7/64	13.941	15.466	12	37.699	113.10	21	65.973	346.36	30	94.248	706.86	39	122.522	1194.6
11/64	1.2763	.12962	4 1/16	14.137	15.904	12 1/64	38.092	115.47	21 1/64	66.366	350.50	30 1/64	94.640	712.70	39 1/64	122.915	1202.3
3/16	1.3744	.15033	4 9/64	14.334	16.349	12 1/32	38.485	117.86	21 1/32	66.759	354.66	30 1/32	95.033	718.69	39 1/32	123.308	1210.0
13/64	1.4726	.17257	4 5/32	14.530	16.800	12 3/64	38.877	120.28	21 3/64	67.152	358.84	30 3/64	95.426	724.64	39 3/64	123.700	1217.7
			4 11/64	14.726	17.257	12 1/16	39.270	122.72	21 1/16	67.544	363.05	30 1/16	95.819	730.62	39 1/16	124.093	1225.4
7/32	1.5708	.19635	4 3/16	14.923	17.721	12 5/64	39.663	125.19	21 5/64	67.937	367.28	30 5/64	96.211	736.62	39 5/64	124.486	1233.2
15/64	1.6690	.22166	4 13/64	15.119	18.190	12 3/32	40.055	127.68	21 3/32	68.330	371.54	30 3/32	96.604	742.64	39 3/32	124.878	1241.0
1/4	1.7671	.24850	4 7/32	15.315	18.665	12 7/64	40.448	130.19	21 7/64	68.722	375.83	30 7/64	96.997	748.69	39 7/64	125.271	1248.8
17/64	1.8653	.27688	4 15/64	15.512	19.147												
9/32	1.9635	.30680				13	40.841	132.73	22	69.115	380.13	31	97.389	754.77	40	125.664	1256.6
19/64	2.0617	.33824	5	15.708	19.635	13 1/64	41.233	135.30	22 1/64	69.508	384.46	31 1/64	97.782	760.87	40 1/64	126.056	1264.5
5/16	2.1598	.37122	5 1/64	15.904	20.129	13 1/32	41.626	137.89	22 1/32	69.900	388.82	31 1/32	98.175	766.99	40 1/32	126.449	1272.4
21/64	2.2580	.40574	5 1/32	16.101	20.629	13 3/64	42.019	140.50	22 3/64	70.293	393.20	31 3/64	98.567	773.14	40 3/64	126.842	1280.3
			5 3/64	16.297	21.135	13 1/16	42.412	143.14	22 1/16	70.686	397.61	31 1/16	98.960	779.31	40 1/16	127.235	1288.2
11/32	2.3562	.44179	5 1/16	16.493	21.648	13 5/64	42.804	145.80	22 5/64	71.079	402.04	31 5/64	99.353	785.51	40 5/64	127.627	1296.2
23/64	2.4544	.47937	5 5/64	16.690	22.166	13 3/32	43.197	148.49	22 3/32	71.471	406.49	31 3/32	99.746	791.73	40 3/32	128.020	1304.2
3/8	2.5525	.51849	5 3/32	16.886	22.691	13 7/64	43.590	151.20	22 7/64	71.864	410.97	31 7/64	100.138	797.98	40 7/64	128.413	1312.2
25/64	2.6507	.55914	5 7/64	17.082	23.221												
13/32	2.7489	.60132	5 1/16	17.279	23.758	14	43.982	153.94	23	72.257	415.48	32	100.531	804.25	41	128.805	1320.3
27/64	2.8471	.64504	5 9/64	17.475	24.301	14 1/64	44.375	156.70	23 1/64	72.649	420.00	32 1/64	100.924	810.54	41 1/64	129.198	1328.3
7/16	2.9452	.69029	5 5/32	17.671	24.850	14 1/32	44.768	159.48	23 1/32	73.042	424.56	32 1/32	101.316	816.86	41 1/32	129.591	1336.3
29/64	3.0434	.73708	5 11/64	17.686	25.406	14 3/64	45.160	162.30	23 3/64	73.435	429.13	32 3/64	101.709	823.21	41 3/64	129.983	1344.3
			5 3/16	18.064	25.967	14 1/16	45.553	165.13	23 1/16	73.827	433.74	32 1/16	102.102	829.58	41 1/16	130.376	1352.7
1	3.1416	.7854	5 13/64	18.261	26.535	14 5/64	45.946	167.99	23 5/64	74.220	438.36	32 5/64	102.494	835.97	41 5/64	130.769	1360.8
1 1/32	3.3379	.8866	5 7/32	18.457	27.109	14 3/32	46.338	170.87	23 3/32	74.613	443.01	32 3/32	102.887	842.39	41 3/32	131.161	1369.0
1 1/16	3.5343	.9940	5 15/64	18.653	27.688	14 7/64	46.731	173.78	23 7/64	75.006	447.69	32 7/64	103.280	848.83	41 7/64	131.554	1377.2
1 1/32	3.7306	1.1075															
1 1/16	3.9270	1.2272	6	18.850	28.274	15	47.124	176.71	24	75.398	452.39	33	103.673	855.30	42	131.947	1385.4
1 1/32	4.1233	1.3530	6 1/64	19.242	29.465	15 1/64	47.517	179.67	24 1/64	75.791	457.11	33 1/64	104.065	861.79	42 1/64	132.340	1393.7
1 3/32	4.3197	1.4849	6 1/32	19.635	30.680	15 1/32	47.909	182.65	24 1/32	76.184	461.86	33 1/32	104.458	868.31	42 1/32	132.732	1402.0
1 1/16	4.5160	1.6230	6 3/64	20.028	31.919	15 3/64	48.302	185.66	24 3/64	76.576	466.64	33 3/64	104.851	874.85	42 3/64	133.125	1410.3
1 5/32	4.7124	1.7671	6 1/16	20.420	33.183	15 1/16	48.695	188.69	24 1/16	76.969	471.44	33 1/16	105.243	881.41	42 1/16	133.518	1418.6
1 1/16	4.9087	1.9175	6 5/64	20.813	34.472	15 5/64	49.087	191.75	24 5/64	77.362	476.26	33 5/64	105.636	888.00	42 5/64	133.910	1427.0
1 7/32	5.1051	2.0739	6 3/32	21.206	35.785	15 3/32	49.480	194.83	24 3/32	77.754	481.11	33 3/32	106.029	894.62	42 3/32	134.303	1435.4
1 1/4	5.3014	2.2365	6 7/64	21.598	37.122	15 7/64	49.873	197.93	24 7/64	78.147	485.98	33 7/64	106.421	901.26	42 7/64	134.696	1443.8
1 3/32	5.4978	2.4053															
1 1/16	5.6941	2.5802	7	21.991	38.485	16	50.265	201.06	25	78.540	490.87	34	106.814	907.92	43	135.088	1452.2
1 5/32	5.8905	2.7612	7 1/64	22.384	39.871	16 1/64	50.658	204.22	25 1/64	78.933	495.79	34 1/64	107.207	914.61	43 1/64	135.481	1460.7
1 1/4	6.0868	2.9483	7 1/32	22.776	41.282	16 1/32	51.051	207.39	25 1/32	79.325	500.74	34 1/32	107.600	921.32	43 1/32	135.874	1469.1
			7 3/64	23.169	42.718	16 3/64	51.444	210.60	25 3/64	79.718	505.71	34 3/64	107.992	928.06	43 3/64	136.267	1477.6
2	6.2832	3.1416	7 1/16	23.562	44.179	16 1/16	51.836	213.82	25 1/64	80.111	510.71	34 1/64	108.385	934.82	43 1/64	136.659	1486.2
2 1/32	6.4795	3.3410	7 5/64	23.955	45.664	16 5/64	52.229	217.08	25 5/64	80.503	515.72	34 5/64	108.778	941.61	43 5/64	137.052	1494.7
2 1/16	6.6759	3.5466	7 3/32	24.347	47.173	16 3/32	52.622	220.35	25 3/64	80.896	520.77	34 3/64	109.170	948.42	43 3/64	137.445	1503.3
2 1/32	6.8722	3.7583	7 7/64	24.740	48.707	16 7/64	53.014	223.65	25 1/16	81.289	525.84	34 1/16	109.563	955.25	43 1/16	137.837	1511.9
2 1/16	7.0686	3.9761															
2 1/32	7.2649	4.2000	8	25.133	50.265	17	53.407	226.98									
2 1/16	7.4613	4.4301	8 1/64	25.525	51.849	17 1/64	53.800	230.33	26	81.681	530.93	35	109.956	962.11	44	138.230	1520.5
2 3/32	7.6576	4.6664	8 1/32	25.918	53.456	17 1/32	54.192	233.71	26 1/64	82.074	536.05	35 1/64	110.348	969.00	44 1/64	138.623	1529.2
2 1/16	7.8540	4.9087	8 3/64	26.311	55.088	17 3/64	54.585	237.10	26 1/32	82.467	541.19	35 1/32	110.741	975.91	44 1/32	139.015	1537.9
2 5/32	8.0503	5.1572	8 1/16	26.704	56.745	17 1/16	54.978	240.53	26 3/64	82.860	546.35	35 3/64	111.134	982.84	44 3/64	139.408	1546.6
2 1/16	8.2467	5.4119	8 5/64	27.096	58.426	17 5/64	55.371	243.98	26 1/16	83.252	551.55	35 1/16	111.527	989.80	44 1/16	139.801	1555.3
2 7/32	8.4430	5.6727	8 3/32	27.489	60.132	17 3/32	55.763	247.45	26 5/64	83.645	556.76	35 5/64	111.919	996.87	44 5/64	140.194	1564.0
2 1/4	8.6394	5.9396	8 7/64	27.882	61.862	17 7/64	56.156	250.95	26 3/32	84.038	562.00	35 3/32	112.312	1003.8	44 3/32	140.586	1572.8
2 9/32	8.8357	6.2126							26 7/64	84.430	567.27	35 7/64	112.705	1010.8	44 7/64	140.979	1581.6
2 5/16	9.0321	6.4918	9	28.274	63.617	18	56.549	254.47									
2 11/32	9.2284	6.7771	9 1/64	28.667	65.397	18 1/64	56.941	258.02	27	84.823	572.56	36	113.097	1017.9	45	141.372	1590.4
			9 1/32	29.060	67.201	18 1/32	57.334	261.59	27 1/64	85.216	577.87	36 1/64	113.490	1025.0	45 1/64	141.764	1599.3
3	9.4248	7.0686	9 3/64	29.452	69.029	18 3/64	57.727	265.18	27 1/32	85.608	583.21	36 1/32	113.883	1032.1	45 1/32	142.157	1608.0
3 1/32	9.6211	7.3662	9 1/16	29.845	70.882	18 1/16	58.119	268.80	27 3/64	86.001	588.57	36 3/64	114.275	1039.2	45 3/64	142.550	1617.0
3 1/16	9.8175	7.6699	9 5/64	30.238	72.760	18 5/64	58.512	272.45	27 1/16	86.394	593.96	36 1/16	114.668	1046.3	45 1/16	142.942	1626.0
3 3/32	10.014	7.9798	9 3/32	30.631	74.662	18 3/32	58.905	276.12	27 5/64	86.786	599.37	36 5/64	115.061	1053.5	45 5/64	143.335	1634.9
3 1/16	10.210	8.2958	9 7/64	31.023	76.589	18 7/64	59.298	279.81	27 3/32	87.179	604.81	36 3/64	115.454	1060.7	45 3/64	143.728	1643.9
3 5/32	10.407	8.6179							27 7/64	87.572	610.27	36 7/64	115.846	1068.0	45 7/64	144.121	1652.9
3 1/16	10.603	8.9462	10	31.416	78.540	19	59.690	283.53									
3 7/32	10.799	9.2806	10 1/64	31.809	80.516	19 1/64	60.083	287.27	28	87.965	615.75	37	116.239	1075.2	46	144.513	1661.9
3 1/16	10.996	9.6211	10 1/32	32.201	82.516	19 1/32	60.476	291.04	28 1/64	88.357	621.26	37 1/64	116.632	1082.5	46 1/64	144.906	1670.9
3 9/32	11.192	9.9678	10 3/64	32.594	84.541	19 3/64	60.868	294.83	28 1/32	88.750	626.80	37 1/32	117.024	1089.8	46 1/32	145.299	1680.0
									28 3/64	89.143	632.36	37 3/64	117.417	1097.1	46 3/64	145.691	1689.1

LINEAR MEASURES

Length

1 millimeter — 0.001 in.
1 in. — 2.54 centimeters — 25.4 millimeters
1 link — 7.92 in. — 20.12 centimeters
12 in. — 1 ft — .30479 meter — 30.5 centimeters
3 ft — 1 yd — .91437 meter — 36 in.
5½ yd — 1 rod or pole — 16½ ft — 198 in.
22 yd — 1 chain — 4 rods — 66 ft — 100 links.
40 rods — 1 furlong — 220 yd — 600 ft.
8 furlongs — 1 statute or land mile — 320 rods — 1,760 yd
5.280 ft — 1 statute or land mile — 1,609 kilometers.
1 geographical or nautical mile — 1 minute — 1/60 deg
1 nautical mile, British standard — 6,080 ft
1 nautical mile — 1.1515 statute or land miles.
1 statute or land mile — .869 nautical miles.
3 nautical miles — 1 league.

Diam. In.	Circum. In.	Area Sq. In.
46 1/2	146.084	1698.2
46 5/8	146.477	1707.4
46 3/4	146.869	1716.5
46 7/8	147.262	1725.7
47	147.655	1734.9
47 1/8	148.048	1744.2
47 1/4	148.440	1753.5
47 3/8	148.833	1762.7
47 1/2	149.226	1772.1
47 5/8	149.618	1781.4
47 3/4	150.011	1790.8
47 7/8	150.404	1800.1
48	150.796	1809.6
48 1/8	151.189	1819.0
48 1/4	151.582	1828.5
48 3/8	151.975	1837.9
48 1/2	152.367	1847.5
48 5/8	152.760	1857.0
48 3/4	153.153	1866.5
48 7/8	153.545	1876.1
49	153.938	1885.7
49 1/8	154.331	1895.4
49 1/4	154.723	1905.0
49 3/8	155.116	1914.7
49 1/2	155.509	1924.4
49 5/8	155.902	1934.2
49 3/4	156.294	1943.9
49 7/8	156.687	1953.7
50	157.080	1963.5
50 1/8	157.472	1973.3
50 1/4	157.865	1983.2
50 3/8	158.258	1993.1
50 1/2	158.650	2003.0
50 5/8	159.043	2012.9
50 3/4	159.436	2022.8
50 7/8	159.829	2032.8
51	160.221	2042.8
51 1/8	160.614	2052.8
51 1/4	161.007	2062.9
51 3/8	161.399	2073.0
51 1/2	161.792	2083.1
51 5/8	162.185	2093.2
51 3/4	162.577	2103.3
51 7/8	162.970	2113.5
52	163.363	2123.7
52 1/8	163.756	2133.9
52 1/4	164.148	2144.2
52 3/8	164.541	2154.5
52 1/2	164.934	2164.8
52 5/8	165.326	2175.1
52 3/4	165.719	2185.4
52 7/8	166.112	2195.8
53	166.504	2206.2
53 1/8	166.897	2216.6
53 1/4	167.290	2227.0
53 3/8	167.683	2237.5
53 1/2	168.075	2248.0
53 5/8	168.468	2258.5
53 3/4	168.861	2269.1
53 7/8	169.253	2279.6
54	169.646	2290.2
54 1/8	170.039	2300.8
54 1/4	170.431	2311.5
54 3/8	170.824	2322.1
54 1/2	171.217	2332.8
54 5/8	171.609	2343.5
54 3/4	172.002	2354.3
54 7/8	172.395	2365.0
55	172.788	2375.8
55 1/8	173.180	2386.6
55 1/4	173.573	2397.5
55 3/8	173.966	2408.3
55 1/2	174.358	2419.2
55 5/8	174.751	2430.1
55 3/4	175.144	2441.1
55 7/8	175.536	2452.0
56	175.929	2463.0
56 1/8	176.322	2474.0
56 1/4	176.715	2485.0
56 3/8	177.107	2496.1
56 1/2	177.500	2507.2
56 5/8	177.893	2518.3
56 3/4	178.285	2529.4
56 7/8	178.678	2540.6
57	179.071	2551.8
57 1/8	179.463	2563.0
57 1/4	179.856	2574.2
57 3/8	180.249	2585.4
57 1/2	180.642	2596.7
57 5/8	181.034	2608.0
57 3/4	181.427	2619.4
57 7/8	181.820	2630.7
58	182.212	2642.1
58 1/8	182.605	2653.5
58 1/4	182.998	2664.9
58 3/8	183.390	2676.4
58 1/2	183.783	2687.8
58 5/8	184.176	2699.3
58 3/4	184.569	2710.9
58 7/8	184.961	2722.4
59	185.354	2734.0
59 1/8	185.747	2745.6
59 1/4	186.139	2757.2
59 3/8	186.532	2768.8
59 1/2	186.925	2780.5
59 5/8	187.317	2792.2
59 3/4	187.710	2803.9
59 7/8	188.103	2815.7
60	188.496	2827.4
60 1/8	188.888	2839.2
60 1/4	189.281	2851.0
60 3/8	189.674	2862.9
60 1/2	190.066	2874.8
60 5/8	190.459	2886.6
60 3/4	190.852	2898.6
60 7/8	191.244	2910.5
61	191.637	2922.5
61 1/8	192.030	2934.5
61 1/4	192.423	2946.5
61 3/8	192.815	2958.5
61 1/2	193.208	2970.6
61 5/8	193.601	2982.7
61 3/4	193.993	2994.8
61 7/8	194.386	3006.9
62	194.779	3019.1
62 1/8	195.171	3031.3
62 1/4	195.564	3043.5
62 3/8	195.957	3055.7
62 1/2	196.350	3068.0
62 5/8	196.742	3080.3
62 3/4	197.135	3092.6
62 7/8	197.528	3104.9
63	197.920	3117.2
63 1/8	198.313	3120.6
63 1/4	198.706	3142.0
63 3/8	199.098	3154.5
63 1/2	199.491	3166.9
63 5/8	199.884	3179.4
63 3/4	200.277	3191.9
63 7/8	200.669	3204.4
64	201.062	3217.0
64 1/8	201.455	3229.6
64 1/4	201.847	3242.2
64 3/8	202.240	3254.8
64 1/2	202.633	3267.5
64 5/8	203.025	3280.1
64 3/4	203.418	3292.8
64 7/8	203.811	3305.6
65	204.204	3318.3
65 1/8	204.596	3331.1
65 1/4	204.989	3343.9
65 3/8	205.382	3356.7
65 1/2	205.774	3369.6
65 5/8	206.167	3382.4
65 3/4	206.560	3395.3
65 7/8	206.952	3408.2
66	207.345	3421.2
66 1/8	207.738	3434.2
66 1/4	208.131	3447.2
66 3/8	208.523	3460.2
66 1/2	208.916	3473.2
66 5/8	209.309	3486.3
66 3/4	209.701	3499.4
66 7/8	210.094	3512.5
67	210.487	3525.7
67 1/8	210.879	3538.8
67 1/4	211.272	3552.0
67 3/8	211.665	3565.2
67 1/2	212.058	3578.5
67 5/8	212.450	3591.7
67 3/4	212.843	3605.0
67 7/8	213.236	3618.3
68	213.628	3631.7
68 1/8	214.021	3645.0
68 1/4	214.414	3658.4
68 3/8	214.806	3671.8
68 1/2	215.199	3685.3
68 5/8	215.592	3698.7
68 3/4	215.984	3712.2
68 7/8	216.377	3725.7
69	216.770	3739.3
69 1/8	217.163	3752.8
69 1/4	217.555	3766.4
69 3/8	217.948	3780.0
69 1/2	218.341	3793.7
69 5/8	218.733	3807.8
69 3/4	219.126	3821.0
69 7/8	219.519	3834.7
70	219.911	3848.5
70 1/8	220.304	3862.2
70 1/4	220.697	3876.0
70 3/8	221.090	3889.8
70 1/2	221.482	3903.6
70 5/8	221.875	3917.5
70 3/4	222.268	3931.4
70 7/8	222.660	3945.3
71	223.053	3959.2
71 1/8	223.446	3973.1
71 1/4	223.838	3987.1
71 3/8	224.231	4001.1
71 1/2	224.624	4015.2
71 5/8	225.017	4029.2
71 3/4	225.409	4043.3
71 7/8	225.802	4057.4
72	226.195	4071.5
72 1/8	226.587	4085.7
72 1/4	226.980	4099.8
72 3/8	227.373	4114.0
72 1/2	227.765	4128.2
72 5/8	228.158	4142.5
72 3/4	228.551	4156.8
72 7/8	228.944	4171.1
73	229.336	4185.4
73 1/8	229.729	4199.7
73 1/4	230.122	4214.1
73 3/8	230.514	4228.5
73 1/2	230.907	4242.9
73 5/8	231.300	4257.4
73 3/4	231.692	4271.8
73 7/8	232.085	4286.3
74	232.478	4300.8
74 1/8	232.871	4315.4
74 1/4	233.263	4329.9
74 3/8	233.656	4344.5
74 1/2	234.049	4359.2
74 5/8	234.441	4373.8
74 3/4	234.834	4388.5
74 7/8	235.227	4403.1
75	235.619	4417.9
75 1/8	236.012	4432.6
75 1/4	236.405	4447.4
75 3/8	236.798	4462.2
75 1/2	237.190	4477.0
75 5/8	237.583	4491.8
75 3/4	237.976	4506.7
75 7/8	238.368	4521.5
76	238.761	4536.5
76 1/8	239.154	4551.4
76 1/4	239.546	4566.4
76 3/8	239.939	4581.3
76 1/2	240.332	4596.3
76 5/8	240.725	4611.4
76 3/4	241.117	4626.4
76 7/8	241.510	4641.5
77	241.903	4656.6
77 1/8	242.295	4671.8
77 1/4	242.688	4686.9
77 3/8	243.081	4702.1
77 1/2	243.473	4717.3
77 5/8	243.866	4732.5
77 3/4	244.259	4747.8
77 7/8	244.652	4763.1
78	245.044	4778.4
78 1/8	245.437	4793.7
78 1/4	245.830	4809.0
78 3/8	246.222	4824.4
78 1/2	246.615	4839.8
78 5/8	247.008	4855.2
78 3/4	247.400	4870.7
78 7/8	247.793	4886.2
79	248.186	4901.7
79 1/8	248.579	4917.2
79 1/4	248.971	4932.7
79 3/8	249.364	4948.3
79 1/2	249.757	4963.9
79 5/8	250.149	4979.5
79 3/4	250.542	4995.2
79 7/8	250.935	5010.9
80	251.327	5026.5
80 1/8	251.720	5042.3
80 1/4	252.113	5058.0
80 3/8	252.506	5073.8
80 1/2	252.898	5089.6
80 5/8	253.291	5105.4
80 3/4	253.684	5121.2
80 7/8	254.076	5137.1
81	254.469	5153.0
81 1/8	254.862	5168.9
81 1/4	255.254	5184.9
81 3/8	255.647	5200.8
81 1/2	256.040	5216.8
81 5/8	256.433	5232.8
81 3/4	256.825	5248.9
81 7/8	257.218	5264.9
82	257.611	5281.0
82 1/8	258.003	5297.1
82 1/4	258.396	5313.3
82 3/8	258.789	5329.4
82 1/2	259.181	5345.6
82 5/8	259.574	5361.8
82 3/4	259.967	5378.1
82 7/8	260.359	5394.3
83	260.752	5410.6
83 1/8	261.145	5426.9
83 1/4	261.538	5443.3
83 3/8	261.930	5459.6
83 1/2	262.323	5476.0
83 5/8	262.716	5492.4
83 3/4	263.108	5508.8
83 7/8	263.501	5525.3
84	263.894	5541.8
84 1/8	264.286	5558.3
84 1/4	264.679	5574.8
84 3/8	265.072	5591.4
84 1/2	265.465	5607.9
84 5/8	265.857	5624.5
84 3/4	266.250	5641.2
84 7/8	266.643	5657.8
85	267.035	5674.5
85 1/8	267.428	5691.2
85 1/4	267.821	5707.9
85 3/8	268.213	5724.7
85 1/2	268.607	5741.5
85 5/8	268.999	5758.3
85 3/4	269.392	5775.1
85 7/8	269.784	5791.9
86	270.177	5808.8
86 1/8	270.570	5825.7
86 1/4	270.962	5842.6
86 3/8	271.355	5859.6
86 1/2	271.748	5876.5
86 5/8	272.140	5893.5
86 3/4	272.538	5910.6
86 7/8	272.926	5927.6
87	273.319	5944.7
87 1/8	273.711	5961.8
87 1/4	274.104	5978.9
87 3/8	274.497	5996.0
87 1/2	274.889	6013.2
87 5/8	275.282	6030.4
87 3/4	275.675	6047.6
87 7/8	276.067	6064.9
88	276.460	6082.1
88 1/8	276.853	6099.4
88 1/4	277.246	6116.7
88 3/8	277.638	6134.1
88 1/2	278.031	6151.4
88 5/8	278.424	6168.8
88 3/4	278.816	6186.2
88 7/8	279.209	6203.7
89	279.602	6221.1
89 1/8	279.994	6238.6
89 1/4	280.387	6256.1
89 3/8	280.780	6273.7
89 1/2	281.173	6291.2
89 5/8	281.565	6308.8
89 3/4	281.958	6326.4
89 7/8	282.351	6344.1
90	282.743	6361.7
90 1/8	283.136	6379.4
90 1/4	283.529	6397.1
90 3/8	283.921	6414.9
90 1/2	284.314	6432.6
90 5/8	284.707	6450.4
90 3/4	285.100	6468.2
90 7/8	285.492	6486.0
91	285.885	6503.9
91 1/8	286.278	6521.8
91 1/4	286.670	6539.7
91 3/8	287.063	6555.6
91 1/2	287.456	6575.9
91 5/8	287.848	6593.5
91 3/4	288.241	6611.5
91 7/8	288.634	6629.6
92	289.027	6647.6
92 1/8	289.419	6665.7
92 1/4	289.812	6683.8
92 3/8	290.205	6701.9
92 1/2	290.597	6720.1
92 5/8	290.990	6738.2
92 3/4	291.383	6756.4
92 7/8	291.775	6774.7
93	292.168	6792.9
93 1/8	292.561	6811.2
93 1/4	292.954	6829.5
93 3/8	293.346	6847.8
93 1/2	293.739	6866.1
93 5/8	294.132	6884.5
93 3/4	294.524	6902.9
93 7/8	294.917	6921.3
94	295.310	6939.8
94 1/8	295.702	6958.2
94 1/4	296.095	6976.7
94 3/8	296.488	6995.3
94 1/2	296.881	7013.8
94 5/8	297.273	7032.4
94 3/4	297.666	7051.0
94 7/8	298.059	7069.6
95	298.451	7088.2
95 1/8	298.844	7106.9
95 1/4	299.237	7125.6
95 3/8	299.629	7144.3
95 1/2	300.022	7163.0
95 5/8	300.415	7181.8
95 3/4	300.807	7200.6
95 7/8	301.200	7219.4
96	301.593	7238.2
96 1/8	301.986	7257.1
96 1/4	302.378	7276.0
96 3/8	302.771	7294.9
96 1/2	303.164	7313.8
96 5/8	303.556	7332.8
96 3/4	303.949	7351.8
96 7/8	304.342	7370.8
97	304.734	7389.8
97 1/8	305.127	7408.9
97 1/4	305.520	7428.0
97 3/8	305.913	7447.1
97 1/2	306.305	7466.2
97 5/8	306.698	7485.3
97 3/4	307.091	7504.5
97 7/8	307.483	7523.7
98	307.876	7543.0
98 1/8	308.269	7562.2
98 1/4	308.661	7581.5
98 3/8	309.054	7600.8
98 1/2	309.447	7620.1
98 5/8	309.840	7639.5
98 3/4	310.232	7658.9
98 7/8	310.625	7678.3
99	311.018	7697.7
99 1/8	311.410	7717.1
99 1/4	311.803	7736.6
99 3/8	312.196	7756.1
99 1/2	312.588	7775.6
99 5/8	312.981	7795.2
99 3/4	313.374	7814.8
99 7/8	313.767	7834.4
100	314.159	7854.0

MEASUREMENTS

Areas

Parallelogram — base × altitude

Triangle — half base × altitude

Trapezoid — half the sum of the two parallel sides × the perpendicular distance between them.

Regular polygon — half of perimeter × the perpendicular distance for the center to any one side.

Circle — square of the diameter × .7854.

Sector of circle — number of degrees in arc × square of radius × 0.008727.

Segment of circle — area of sector with same arc minus area of triangle formed by radii of the arc and chord of the segment.

Octagon — square of diameter of inscribed circle × .828.

Hexagon — square of diameter of inscribed circle × .866.

Sphere — area of its great circle × 4; or square of diameter × 3.14159.

Volumes

Prism — area of base × altitude.

Wedge — length of edge plus twice length of base × one-sixth of the product of the height of the wedge and the breadth of its base.

Cylinder — area of base × altitude.

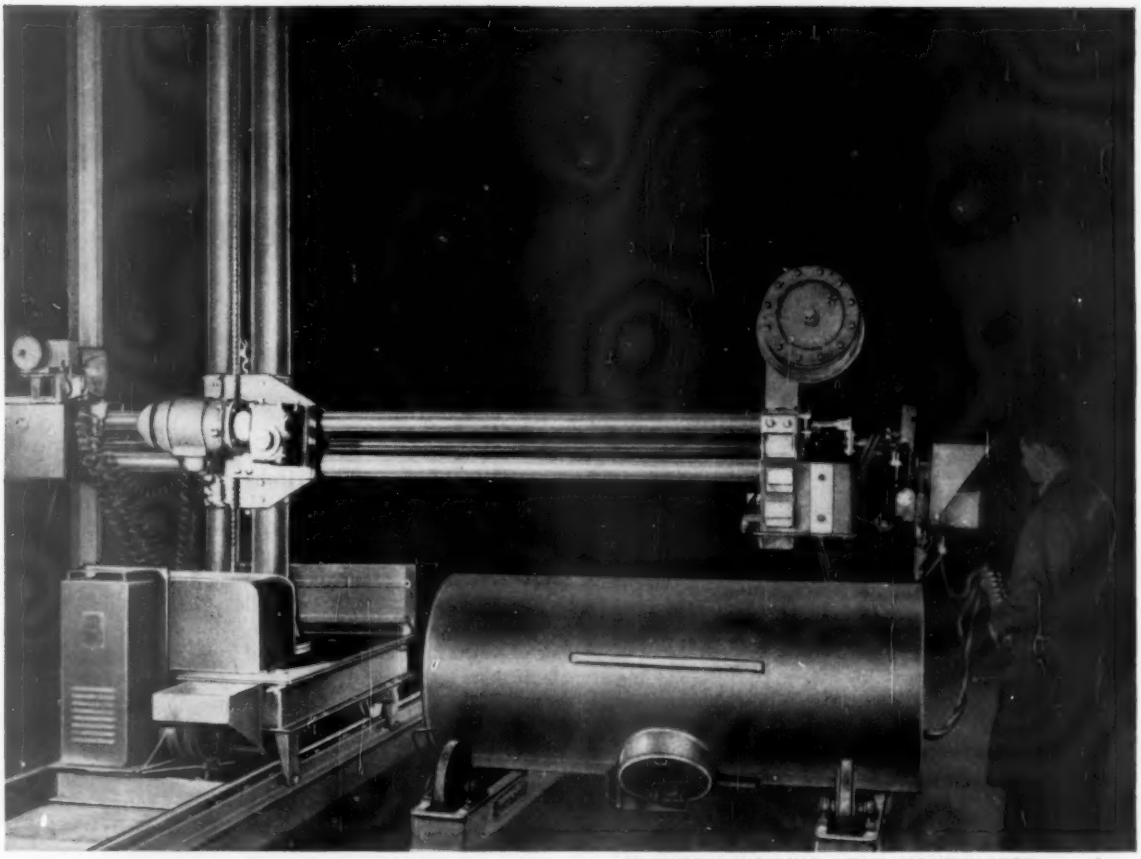
Cone — area of base × one-third of altitude.

Sphere — cube of diameter × 0.5236.

Miscellaneous

Diameter of circle — circumference × .31831.

Circumference of circle — diameter × 3.1416.



PRECISION WELDING HEAD MANIPULATOR completes Worthington's welding equipment line. Supplied with welding head and accessories of customer's choice.

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Only Worthingon now offers complete equipment line plus nationwide sales and service

Now you can get all the basic equipment you need for your automatic welding operations from Worthington.

With the addition of this new, custom-manufactured precision-designed welding head manipulator to its line of welding positioners and turning rolls, Worthington now offers a complete packaged deal to automatic welding equipment users.

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Welding Positioners • Turning Rolls • Manipulators

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CABLE CONNECTORS

- Exclusive Cam-Action!
- Locks Tight!
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Exclusive Cam-Lok design guarantees positive, vibration-proof connection. Locks tightly in about ½ turn. No spring tension, no weaving or moving of contact surfaces, therefore, no arcing, burning, or freezing.

COMPARE POSITIVE LOCK and these CAM-LOK features with your present connectors:

1. High Pressure contact eliminates overheating and current losses.
2. Connects instantly, all cables from #2 to 4/0 without adaptors and without tools.
3. Self-compensating for wear, self-cleaning.
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"QUICK-DISCONNECT"
ELECTRODE HOLDERS
Obsolete all others!

Eliminate need for whips and whip end!

CHECK THESE FEATURES:

- Eliminates need for carrying whips.
- Holder plugs in quickly and easily to any cable merely by attaching holder handle to cable end.
- Less money tied up in cables.
- No electrician and no tools required to change holders.
- Holder and jaws insulated with tough, heat-resistant fibre glass.
- High pressure positive lock.
- Offset jaws eliminate rod bending.
- Offset holder permits burning rods to shorter stubs.
- Choice of offset or straight jaws.

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A former editor recalls . . .

The days of growth

(Harold Card was associated with WELDING ENGINEER for 14 years, and served as Editor from 1925 to 1932.)

REMINISCENCES of old timers on this 40th anniversary could easily fill your book, including the covers. There was, for instance, the memorable experience of sitting in a lecture hall and hearing Sam Miller tell a questioner, "There is only one kind of weld—a good weld. The others are not welds."

And touring the exhibits at an oil show in Tulsa for WELDING ENGINEER, we encountered a huge person in charge of an exhibit of a pressure vessel. The tank, made of 2-in. plate, was held together with 2-in. rivets. We shyly mentioned our interest in welding. Obviously disgusted, he boomed, "You'll never see jobs like *this* welded, Bud!"

I often wished in later years that I could meet that guy again and give him statistics on welded pressure vessels.

Public Weld Test

There were exciting incidents: the first arc welded pipe line in the Chicago area . . . the weldors running at full speed to show the world how many joints they could make in a day.

There was the first public test of a welded pressure vessel at the A. O. Smith plant in Milwaukee; hearing a gas welding expert say that if they did much of this, they would come up with failures that would set the welding industry back many years; hearing a petroleum engineer say that this development would mean many millions of dollars to the petroleum industry.

Rivalry between gas and arc welding was so bitter in spots that some advertisers would count the pages devoted to each process every month and squawk like old hens if the count was against them.

The first gas welding distributor who took on electric equipment to round out his service was roundly berated and his early failure was predicted. To me it looked like the logical thing to do . . . and now they're all doing it.

Editorial Optimism

That rivalry was just one item in the growth of welding. All along the line in the 20's we had viewers-with-alarm among us, who could see certain ruin in every trend that was not down their alley. But we couldn't be a good editor without being an optimist, so we sat in the cheering section instead of the mourner's bench.

One fundamental thing that made an impression was the importance of getting results. There was an immense amount of engineering opposition to welding, but when good results showed up in boilers and pressure vessels, in pipe welding and in structural steel, the conservatism had to give way.

The industry floundered around for years in attempts to write specifications for filler rods and wire, until they switched to writing specs that were based on performance and on the properties of deposited metal.

Workable Codes

In different fields of application they got nowhere writing codes telling how to do a job. Then they got into process qualifications based on results and soon had workable codes.

For the future, I haven't much to offer except progress. The welding market will grow because facilities for making steel, aluminum, copper and magnesium are all being enlarged, and you don't fabricate these metals and their alloys without welding.

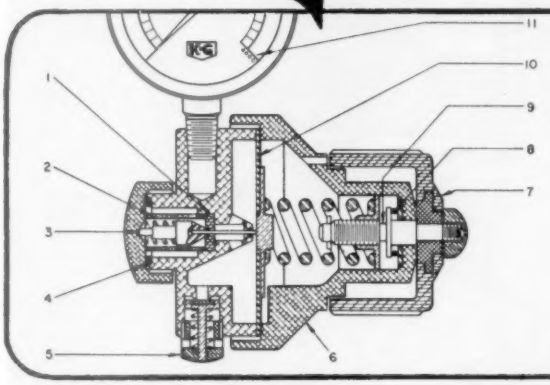
I believe that there will always be a demand for skill in the welding industry, and that there will never be too many men available who understand heat effects in welding and what to do about them.

Harold S. Card
Meriden, Connecticut

K-G goes "On Guard" for YOUR Safety and Economy

"On Guard" against breakage and wear

INSIDE and OUT!



1. Reversible Nylon seat.
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3. Stainless steel stem.
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9. Stainless steel internal adjusting mechanism.
10. Large-diameter Neoprene and Nylon diaphragm.
11. 4000 # H.P. gauge.

At last industry has a regulator without a weak spot anywhere. In the new K-G "On Guard" Regulator every vital point is protected against impact, wear, corrosion and other destructive forces.

A major source of damage is eliminated by the patented Gauge Guard with spring lock action, which protects the delicate gauges from accidental breakage. In addition, the careful selection of materials such as stainless steel, Neoprene and body forging of a special aluminum alloy, assures exceptionally long life and *virtually eliminates costly regulator repairs.*

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. . . Guaranteed by K-G and our distributors everywhere. All orders sent to K-G in Allentown will be promptly delivered by the K-G distributor in your area—distributors proud to *sell* and *service* "The Finest". Send for new regulator folder.

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ACCO products

3 Big Reasons for Buying PAGE Automatic Welding Wire

1. Packaged to fit your particular requirements

2. A wide range of analyses to fit a particular job

3. Greatest convenience — you can buy from local stocks

There is every reason why you should look to PAGE for your automatic welding wire needs. For PAGE not only manufactures wire in an extremely wide range of analyses, but packages them in a variety of ways for the most complete protection and convenience in handling and stocking. PAGE Distributors throughout the country carry stocks — this means savings for you, in ordering time and in inventory investment.

Shown above are some of the handy ways PAGE Automatic Welding Wire is packaged...There are lightweight, durable Leverpaks, which provide perfect protection against coil distortion or wire corrosion. They're easily opened and resealed, roll easily, stack perfectly and take a minimum of floor space.

There are single and pallet-mounted (1,000 lb., 2,000 lb., 3,000 lb.) coils, each wrapped in waterproofed paper and held secure by steel strapping; thread-wound, 25-pound reels to fit popular machines; also, coils in individual cardboard cartons, available singly or palletized for handling by fork-lift truck.

Page Offers 26 Analyses in Automatic Welding Wire

In order to provide you with *exactly* the correct automatic welding wire for your specific requirements—no matter how "special" or "different" they may be—PAGE offers no less than 26 different analyses from which to choose. These "cover the waterfront" of applications: heavy automatic submerged arc...light manual submerged arc ...inert gas manual and automatic, tungsten or metal arc.

Carbon Steel • Any carbon from Armco (.025 max.) to high carbon (.90—1.10). All standard AISI analyses in between.

Low Alloys • All the most popular welding grades

Stainless • AISI grade. Other types on request

Following is a list of the *26 analyses* in which PAGE Automatic Welding Wire is readily available:

Page A-S-Armco	Page A-S-110
Page A-S-6	Page A-S-15
Page A-S-10	Page A-S-15-MO
Page A-S-17	Page A-S-3½-Nickel
Page A-S-20	Page A-S-6150
Page A-S-65	Page A-S-4130

Page NAX-9115
Page-Allegheny A-S-Type 304
Page-Allegheny A-S-Type 308
Page-Allegheny A-S-Type 308 ELC
Page-Allegheny A-S-Type 309
Page-Allegheny A-S-Type 310
Page-Allegheny A-S-Type 316
Page-Allegheny A-S-Type 316 ELC
Page-Allegheny A-S-Type 347
Page-Allegheny A-S-Type 348
Page-Allegheny A-S-Type 410
Page-Allegheny A-S-Type 420
Page-Allegheny A-S-Type 430
Page-Allegheny A-S-Type 502

Details of all these analyses are contained in our new Folder DH-402. Write for it!

from Page's Wide Range You Can Get Exactly the Analysis You Need for Each Welding Job

• The *right* electrodes and the *right* rods for every welding job! That is what you must have for perfect operation—and that is what you can expect from the wide range offered by PAGE. Choose what you need from this complete line:

Gas Welding Rods

Armco Gas (GB-45)	Page Armco
Mild Steel (GA-50)	C Gas
Low Alloy (GA & GB-60)	Hi-Tensile M
3½% Nickel (GB-65)	3½% Nickel
.55—.65 Carbon	Medium Carbon
.90—1.10 Carbon	High Carbon
Manganese Bronze	Manganese Bronze
Naval Bronze	Naval Bronze
Stainless Steel	According to AWS analysis

Any Page A-S Automatic Grade in 36" Lengths

Bare Electrodes

Armco	Page Armco
Low Carbon	Page "CE"
.13—.18 Carbon	Page "B"
.55—.65 Carbon	Medium Carbon
.90—1.10 Carbon	High Carbon

Metal Spray Wire

Armco	Page Armco
.10 Carbon	#10
.28 Carbon	#25
.40 Carbon	#40
.60 Carbon	#60
.80 Carbon	#80
1.00 Carbon	#100
3½% Nickel	3½% Nickel
Manganese Bronze	Manganese Bronze
Naval Bronze	Naval Bronze
Stainless Steel Metal Spray	According to AWS Analysis

Convenient Service from Local Stocks

• Whenever you are in need of automatic welding wire, electrodes or welding rods, you can get them quickly and easily from your nearby PAGE Distributor—no matter what part of the country you live in.

PAGE Distributors carry ample stocks from which your requirements can be filled without delay or inconvenience to you. This handy service not only saves you time in getting what you need, but makes it unnecessary for you to make a sizeable investment in inventory. Thus, your nearby PAGE Distributor is able to make double savings for you—a saving in time and a saving in actual dollars.

Get the full Analysis List

All the 26 analyses of PAGE Automatic Welding Wire are set forth in complete detail in new **Folder DH-402.** A free copy of this informative folder will be sent to you on request. Write to our Monessen, Pa., office.

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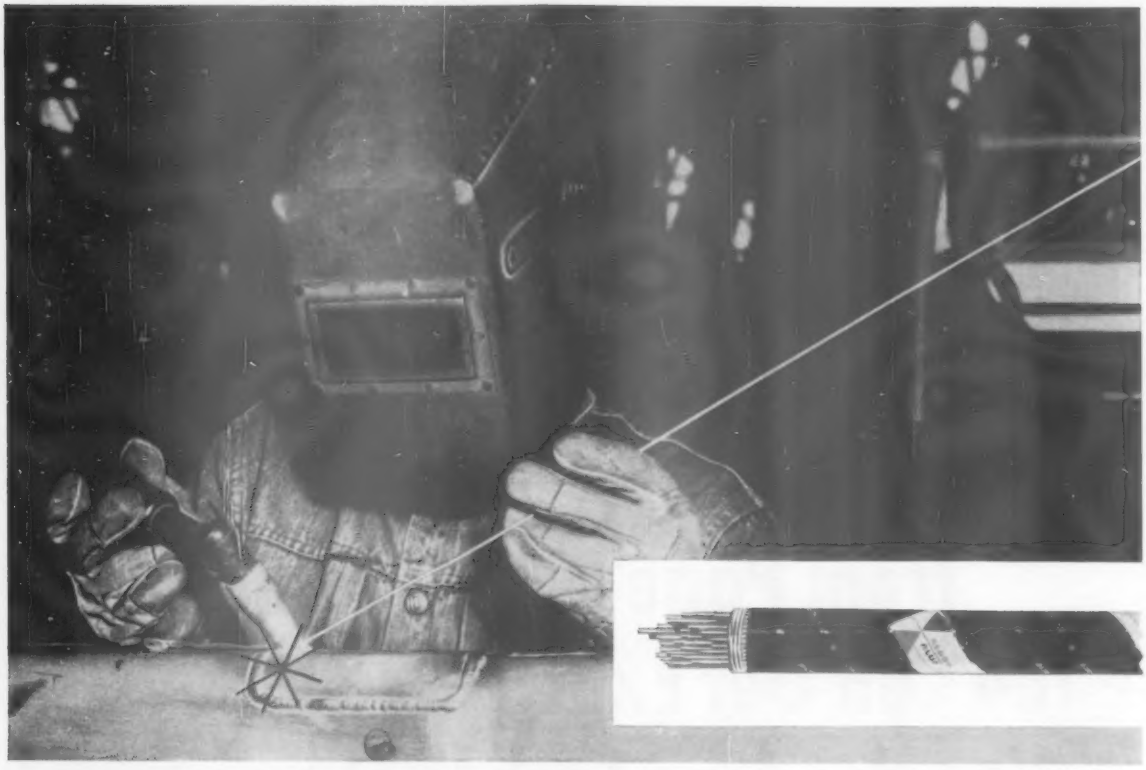

Here* is where you need the superior etched finish of Alcoa Aluminum Welding Rod

Cleaning alone cannot remove heavy oxides and other surface conditions customarily found on "as-drawn" wire surfaces.

Alcoa® Aluminum Welding Rod is *etched* to remove the entire outer layer of metal, leaving a surface that provides maximum rod "wetting" and freedom and control of weld flow.

This fine welding rod is now available in new, moistureproof, dustproof, resealable 5-lb tubes containing 36″ straight lengths in all standard welding alloys and diameters. Buy it from the distributors listed at the right.

ALUMINUM COMPANY OF AMERICA
1740-A Alcoa Bldg.,
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Please send without obligation new, free 176-page book, *Welding Alcoa Aluminum*. Covers every phase of welding in detail.

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Title _____

Company _____

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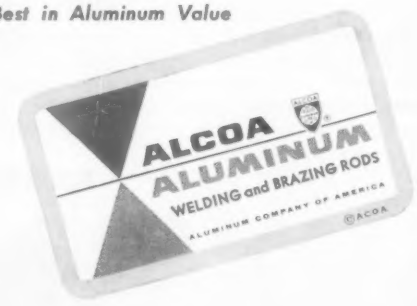
Your Guide to the Best in Aluminum Value



FOR IMMEDIATE DELIVERY, call one of the Alcoa distributors listed below. He carries a complete range of alloys and sizes of Alcoa Etched Finished Welding and Brazing Rod, I. G. Consumable Electrode, Brazing Metal, Solder and Flux.

For technical assistance, contact the nearest Alcoa sales office, listed under "Aluminum" in the yellow pages of your phone book.

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ARIZONA
Phoenix
Ducommun Metals & Supply Co.
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San Francisco
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Edgcomb Steel of New England, Incorporated
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J. M. Tull Metal & Supply Co., Inc.
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Roxbury
Eastern Metal Mill Products Company
MICHIGAN
Detroit
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Minneapolis
Steel Sales Co. of Minnesota
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Sachs Metal Supply Company
Syracuse
Brace-Mueller-Huntley, Inc.
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NORTH CAROLINA
Charlotte
Edgcomb Steel Co.
OHIO
Cincinnati
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Williams & Co., Inc.
Cleveland
Jones & Laughlin Steel Corp.
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Tulsa
Metal Goods Corp.
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Portland
Pacific Metal Co.
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Central Steel & Wire Company
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FLAME-CUTTING ATTACHMENT

Big savings claimed for gas control unit

A NEW flame-cutting attachment, the "Oxomatic Gas Economizer Unit" manufactured by Oxo Equipment Co., Chicago, is said to reduce fuel gas costs over 50% and preheat oxygen costs 35%. A better quality flame cut is also claimed when this unit is used.

The unit was introduced recently to a number of steel fabricators in the Chicago area. The manufacturer says it may be used with any fuel gas and on any type or make of flame-cutting machine employing one or more three-hose torches. The complete control box and unit measures approximately 6 in. deep, 8 in. wide and 8 in. high.

Principles of operation are derived from an arrangement of electrically and manually controlled valves and piping. These valves are controlled by toggle switches integrated in the control unit or actuated with switches from a small remote control panel.

Ideal Conditions

The manufacturer states that ideal cutting conditions are attained through a fast starting time. This can be achieved only with heavy preheat flames. When the base metal is brought to proper temperature and the oxygen cutting jet is initiated, however, heavy preheat flames are no longer necessary.

Once the cut is in progress, heavy preheat flames are actually undesirable and adversely affect the cut: *i.e.*, rolling and melting of the top edges of the kerf occur, and slag is harder to remove. Gas consumption under these conditions is excessive and costly.

The unit has been designed to give highly flexible cutting operations. The operator initiates fuel gas flow and preheat oxygen by toggle switches.

When the metal is ready, high-pressure cutting oxygen is switched on and torch travel is also initiated by a switch. As soon as the cutting jet is turned on, or just afterward, the economizer is started, automatically reducing preheat flames from their high intensity value to a low preheat intensity. This is said to result in a better quality cut and a substantial reduction in costly gas consumption.

The economizer switch controlling the flow of gases may be actuated by the operator at any time. Independent operation allows a high or low flame intensity as needed.

The results of some typical shop tests for gas consumption

With propane—using No. 1 cutting tip

Normal gas consumption	With "gas economizer"
Propane—16 cfh	Propane—7 cfh
Oxygen—77 cfh	Oxygen—40 cfh

A saving of 48% on preheat oxygen
A saving of 56% on propane

With acetylene—using No. 1 cutting tip

Normal gas consumption	With "gas economizer"
Acetylene—15 cfh	Acetylene—6 cfh
Oxygen—42 cfh	Oxygen—26 cfh

A saving of 38% on preheat oxygen
A saving of 60% on preheat acetylene

With acetylene—using No. 3 cutting tip

Normal gas consumption	With "gas economizer"
Acetylene—27 cfh	Acetylene—10 cfh
Oxygen—38 cfh	Oxygen—24 cfh

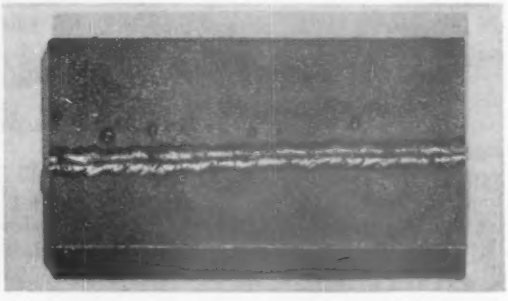
A saving of 37% on preheat oxygen
A saving of 63% on preheat acetylene

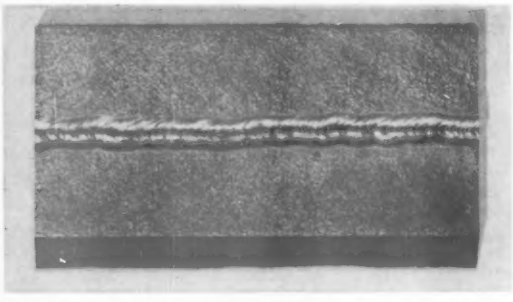
$3800 SAVED! When a transmission housing broke on a 60-ton U. S. Naval Yard railway crane, operations were suspended. The replacement cost of $3800 and a 6-month delay were saved with the Xyron 2-25 weldment illustrated. Careful tests proved the weld was completely free of cross checks and porosity.

Xyron 2-25 has been proven ideal for "cold" repair of large sections such as cracked motor blocks, machine bases, motor and gear housings. Xyron 2-25 makes it possible for the welder to lay in large volumes of filler metal, run long beads without excessive heat build-up in the base metal. All the advantages of Eutectic's "Low Heat Input" welding process has been brought to the arc welding of cast iron.

$20,000 SAVED! When this $20,000 cast iron condenser crashed to the ground, the manufacturer expected to replace it completely or at best to stand an expensive and lengthy repair job. But, with Xyron 2-25 the entire repair was successfully completed in less than 100 hours. The repair was found to be entirely free of cracks and "leakers" and was accomplished without warping or embrittlement of the base metal. The welders performing this job reported amazement with the faster, **non-stop** welding possible with this new Eutectic electrode.

NOW... CRACK-FREE with XYRON 2-25—Eutectic's new



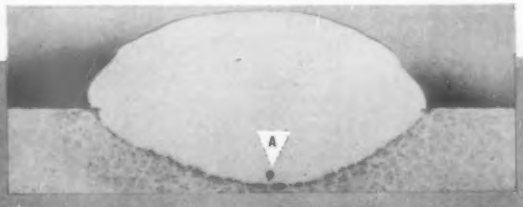


Flame Torture Test Proves XYRON 2-25 Is Non-Cracking

The remarkable non-cracking property of Xyron 2-25 . . . one of its most important advantages over conventional electrodes . . . is proven by this torture test. A cover bead is run on ⅜ inch cast iron plate using Xyron 2-25 and a conventional cast iron electrode. The slag is cleaned and the bead shined with a wire brush. By using a neutral flame with the core near the beads (only the beads are heated, base metal remains cold), each one is heated to a dull red color. Any hidden cracks in the weld deposit will then appear.

The conventional electrode bead shows numerous cracks (left, above). The Xyron 2-25 bead shows no cracks (right, above), proving that none are present and that Xyron 2-25 has the ability to withstand temperature changes.

This photomicrograph reveals one of the secrets of Xyron 2-25's superiority over the usual nickel electrodes. Notice the shallow uniform penetration. The smooth tapered shoulders of this deposit minimize stress formations and aid slag removal, eliminate cracks and "leakers." The extreme fluidity and wetting action of Xyron 2-25 eliminates the need for a lot of electrode manipulation.



This photomicrograph of conventional nickel electrode deposit shows how built-in stresses are caused, resulting in dangerous cracking in service. This electrode gives only a deep, localized penetration with excessive build-up and lack of wash. This deposit is not even machinable at point A. Xyron 2-25 deposits are superior in machinability at every point.

Make This Comparison

EUTECTIC new 1955 DEVELOPMENTS

TECHNICAL ADVANTAGES	CONVENTIONAL NICKEL ELECTRODES	NEW NON-CRACKING EUTECTRODE XYRON 2-25
LOW HEAT INPUT	?	YES
NON-CRACKING	?	YES
CAN BE USED "COLD"	?	YES
CAN BE WELDED "NON-STOP"	?	YES
EASY MACHINABILITY	?	YES
HIGH TENSILE STRENGTH	?	YES
VERSATILITY	?	YES
EASY SLAG REMOVAL	?	YES
PERFECT COLOR MATCH	?	YES
LEAK PROOFNESS	?	YES

CAST IRON WELDING

strontium-aluminum bearing electrode

perfect for all types of gray and ductile cast iron including "Meehanite", "Ni-Resist" and joining cast iron to steel

Here's proof of the superiority of Eutectic's new Xyron 2-25. Just study the comparison chart above and you'll see that Xyron 2-25 gives you everything you want for faster, better welding. The case histories shown are typical of the reports by users all over the country, in extensive tests.

And, Xyron 2-25 is not just another conventional nickel alloy electrode. Its new strontium-aluminum formulation gives Xyron 2-25 higher weld quality and strength by purging the molten filler metal from harmful sulfur and sulphides, purifying it from oxide inclusions and improving the electrode's fluidity. All types of cast iron alloys such as Meehanite, Ni-Resist, and others, cast iron joined to steel, even old, dirty, and oxidized surfaces can be welded without preheating when you use Xyron 2-25. Not only does Xyron 2-25 save you time, but it also minimizes or eliminates the danger of warping, stress or embrittlement of the base metals.

The crack-free feature of this new electrode makes it ideal for the newest metals in the cast iron field. There is no weldable application for cast iron for which Xyron 2-25 cannot be recommended. It is the electrode every weldor has been waiting for.

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Your local Eutectic District Engineer is ready to show you, in your own shop, with your own materials, that Xyron 2-25 will out-perform any nickel cast iron electrode you may now be using. For letting him show you how Xyron 2-25 will let you make better welds at amazing savings in time and labor, he'll give you a pair of burn-resistant welding goggles with unbreakable frames and lenses. They're perfect for torch welding — and they're yours FREE — just for seeing a demonstration. Supplies are limited so make an appointment today with your local Eutectic District Engineer, or, use the coupon.

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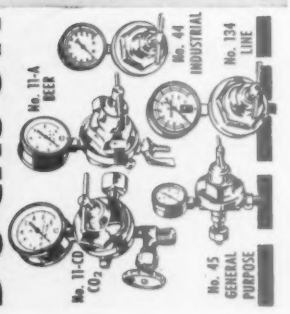

Another celebration

Alloy manufacturer also marks 40 years

A LARGE power-shovel tooth recently was repointed with Stulz-Sickles Co. products for the twenty-first time—each time at a cost of less than half that of a new tooth. That tooth pretty well symbolizes the accomplishments of the company during the past 40 years.

Stulz-Sickles is 40 years old this year. Since the development of 11-13½% manganese-nickel steel welding products in 1928, the company has been directly associated with the welding industry. An ever-growing line of manganese-nickel steel products has been produced for the reclamation welding of worn parts.

Burt H. Payne, now chairman of the board of Stulz-Sickles, was a pioneer in the welding of manganese steel castings with manganese-nickel steel welding electrodes.

In the late 1920's, Payne was struck by the fact that, though manganese-steel railway frogs and crossings gave good service under the impact and abrasion of car wheels, they had to be discarded and replaced when only a small percentage of the total casting was worn away.

There was then no practical way of rebuilding a worn manganese steel frog or crossing and returning it to service. This was expensive scrap, for manganese steel castings cost several times as much as castings of ordinary analyses.

Big Savings Possible

Payne reasoned, therefore, that if an economical and effective way of replacing worn-away metal with portable equipment in the field could be developed, many thousands of dollars and hours of time could be saved by the railroads.

With this in mind, he began a series of experiments in cooperation with several steam railroads. These culminated with the successful development in 1928 of the 11-13½% manganese-nickel steel electrode, with which manganese steel castings have been satisfactorily welded ever since.

Payne had found that embrittlement due to carbides precipitated in the steel by welding heat could be largely controlled by the inclusion of a sufficient amount of nickel in the welding rod.

From this basic discovery grew an entirely new branch of welding—the reclamation welding of worn manganese-steel parts. This process is not merely hardfacing—that comes later when build-up welding is complete—but rather the replacement by welding of worn-away parent metal.

It is a process which has reclaimed many tons of steel which would otherwise have rusted away on scrap piles.

Further Applications

The successful reclamation of manganese steel frogs and crossings gradually became widespread among steam railways, and inevitably led to the spread of this welding technique in the repair of other manganese steel parts. Manganese steel dipper teeth used in excavation were the first additional field of reclamation welding to which Stulz-Sickles turned.

Before the advent of the manganese-nickel steel welding electrode, worn teeth were consigned to the scrap heap. Like the railway castings, they were expensive scrap; teeth were often discarded when as little as 10% of the original parent metal had been worn away.

It was soon found that welding electrodes could be used to rebuild these worn teeth to their original contours, not once, but a number of times.

Good as was the method of rebuilding worn teeth, however, it had one serious drawback: using welding electrodes alone, considerable skill and time was needed to rebuild the tooth to its original sharp contours.

To lick these difficulties, Stulz-

Sickles, in the early 1930's, developed the first of a large family of manganese-nickel steel applicator bars. The first bar was a forged, wedge-shaped piece which conformed to contours of the missing points of worn dipper teeth. It could be welded quickly and easily to the worn stump of a used tooth with manganese-nickel electrodes. These applicator bars minimized the danger of failure, and made the process more economical.

Successful Experiment

To prove that a manganese-nickel wedge properly welded to a worn tooth with electrodes would not fail in service, Stulz-Sickles tried an interesting experiment.

A dipper tooth rebuilt with a wedge and manganese-nickel steel electrodes was installed in the outside corner of the lip of a quarry shovel bucket. The shovel operator was instructed to hook this one rebuilt tooth under a ledge of rock in the quarry wall.

Power was applied to raise the bucket. For a few moments nothing happened as the bucket strained at the ledge. Then, with a roar, the bucket flew up.

Pieces of rock clattered down from the ledge; among them was the rebuilt tooth—torn bodily out of the bucket along with a fair-sized piece of the manganese-steel lip. The weld had proved stronger than the bucket lip itself!

Postwar expansion of industry led Stulz-Sickles into many fields far removed from the strip-mines, quarries, construction jobs and gravel pits of earlier years. As industries became more and more mechanized, applications for manganese-nickel steel were found in many new types of material-handling and processing equipment.

At present, a continuous effort is being made to ferret out still more applications where manganese-nickel steel, because of its unique properties, can overcome wear problems and minimize or eliminate downtime and maintenance costs for an increasing number of industries.

Practical experiments in the field are constantly going on, and a campaign of education in common-sense applications of manganese-nickel steel as a maintenance welding tool is being vigorously pursued.

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FIXTURE swings tank head in arc under automatic submerged-arc welder to complete inner seam.

Home-made fixture for tank head welds

BY A. L. HILL*

LARGE-DIAMETER tank heads, ranging in size from 66 to 110 in., are one of several products fabricated by The Master Tank and Welding Co. of Dallas, Texas, fabricators of LP pressure vessels, refinery vessels and line pipe.

In fabricating heads from 84 to 110 in. in diameter, Master Tank follows the usual design, using a dollar plate and five and seven-formed pieces, respectively. These components formerly were manually welded inside and out.

The 84-in. heads, formed of 11/32-in.-thick steel, could be welded by hand in 9½ hours.

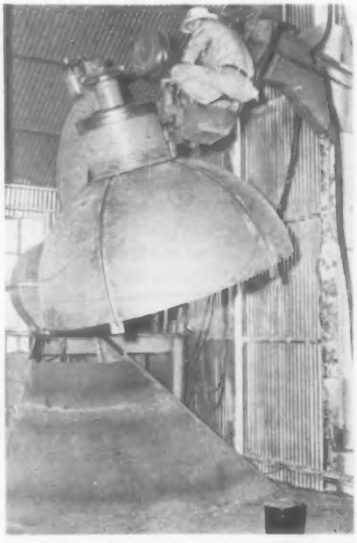
In an effort to reduce fabrication time of this product, the company's engineers designed and built in their own shop a special welding fixture.

Prime advantage of this new fixture is that it allows automatic welding—in this case, the submerged-arc process. The head is tack welded, then mounted on the fixture.

An operator adjusts the submerged-arc unit and operates both welder and fixture by push-button controls. When the inside weld has been finished, position of the head is reversed and the fixture carries the head on a perfect arc under the welder to complete the job.

The combination of the special fixture and automatic welding has reduced welding man-hours on an 84-in. head from 9½ to 2 hours. On a 110-in. head, welding time has dropped from 15 hours to 4 hours.

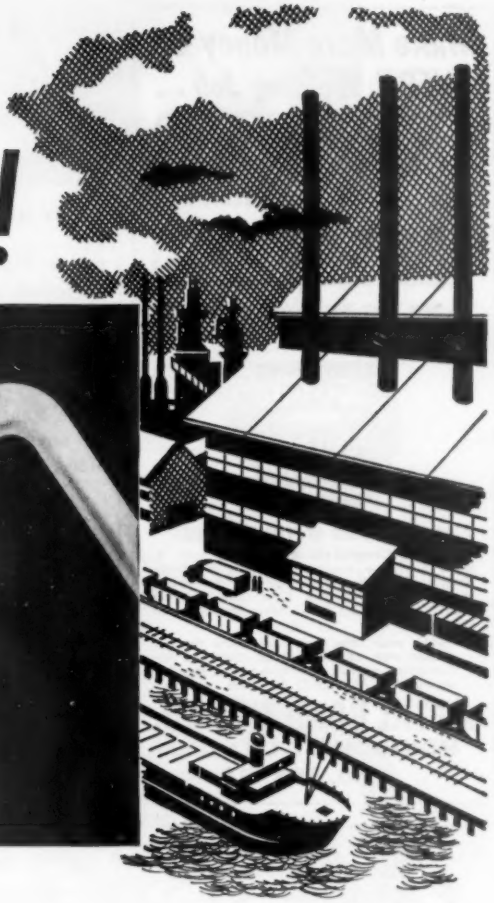
The new welding method, with its corresponding savings in labor and grinding, has increased production over 400%.



RIDING high, operator watches as outer seam of tank head is welded.

*President, Hill Equipment & Supply Co., Dallas, Texas.

TERRIFIC HEAT !



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A U.S. welding executive takes a look at:

Europe—1955

BY RENE D. WASSERMAN*

THE "spirit of Geneva," while it lasted, seemed to encourage foreign travel in 1955 to a greater extent than in any other post-war year. Last year, for the first time, it was really necessary to make hotel, train and other transportation reservations well in advance to secure accommodations.

Europe is going through a period of development that has created a stupendous boom. The 1954 slump in the United States did not affect Europe at all. However, it should be remembered that six years of war were followed by several years during which Europe was busy taking care of its essential needs. It is only in the past few years that they have been able to surpass their 1939 peak of business activity.

With industry and agriculture at a peak, new markets have automatically been created. The higher standard of living has brought about greater activity and increased demands.

The most remarkable manifestation in Europe is the growth of West Germany. The prosperity Germany is enjoying today should continue because the need for goods—consumer goods in particular—is tremendous.

German Activity

Building construction in Germany is something worth seeing. Many interesting expositions are frequently held, especially industrial and automotive shows. In the welding field, improvement asserts itself in the quality of materials offered. Torches, arc welders, electrodes and welding wire are well presented and attractively packaged.

Other European countries present the same busy picture. The *en masse* arrival of Americans helps the countries to earn more hard currency and, at the same time, creates a favorable climate.

It was remarkable to note the great anxiety that President Eisenhower's illness caused all over Europe. People were stunned because they felt that he was solely responsible for "the Geneva spirit."

Mr. Wasserman inspects district engineer's welding demonstration van in Italy.

These people pin far greater hopes on the outcome of top-level conferences than we do because they are so much closer to the Russian danger. It is heart-warming to see that our aid to Europe did not end with the widely respected Marshall Plan. Admiration for American leadership is found everywhere.

Recommends Tour

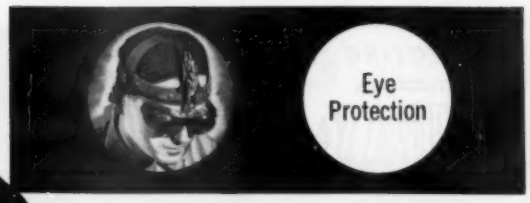
To the American businessman, I highly recommend a trip to Europe. He will find it helpful and broadening. He will get new ideas and eventually be reminded of approaches he once knew and forgot. The whole experience is very stimulating.

Welding is having its own boom in Europe, and the trend toward more welding in construction and fabrication, as well as repair, is moving at a very fast pace. The sale of welding machines and torches, of gases, of electrodes and wire, is growing steadily and the market is expanding rapidly.

The American manufacturer can expect stiff competition.

Europe is not one market, of course, but a multitude of small markets, and it is a pleasure to consider that possibly we may have had something to do with their recovery . . . this prosperity and these happier faces we find as we travel through Europe today.

*President, Eutectic Welding Alloys Corp.



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Quick Facts

- ADJUSTMENT — By thumbscrews to fit facial contours and provide correct pupillary distance. Spring mechanism throws goggle into "off-guard" position.
- HEADGEAR — Fibre, fits snugly. Adjusted by nut turning on right and left hand threaded stud. Genuine leather sweatband.
- EYECUPS — Opaque and fit snugly and comfortably.
- SIDESHIELDS — Light-tight, adequately ventilated indirectly.
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WELDOR makes minor adjustment as Mig welding gun is taken on a machine application over brass hopper seam. Jig to hold welder was shop made.

Double-duty Mig gun

BY GEORGE KOTCHER*

MANY welding jobs present a variety of joining problems. Some of them call for the manueverability of manual welding. Others require the more stabilized conditions of machine welding for best results.

Pabrico Steel Fabricators, Inc., of Paterson, N. J., recently undertook one of these "problem jobs."

The job entailed the production of a series of large brass hoppers of 3/16-in.-thick sheet, measuring 47 in. square with a varying height of 5 to 8 ft. Joints on the hoppers, which are used to feed gun powder in arsenals, indicated a need for both manual and machine welding.

To meet the problem, Pabrico already had a unique welding jig which could be fitted with a single, manual Mig (metal inert-gas) welding gun to take advantage of high speeds on straight runs. Joints which could not be easily positioned for machine welding were welded manually by dismounting the gun from its fixed machine position.

This gun's flexible 10-ft cable gave a wide performance area to the operator when the gun was dismounted for normal use as a manual tool.

Machine welding on the hoppers progressed at speeds of 30 ipm. The Mig gun was mounted on an overhead fixture (designed and built by Pabrico) that moves on rails.

This installation allows a 20-ft straight-line run. It can be raised to a height of 10 ft, and it has a 7-ft movement parallel to the straight run.

Aluminum-bronze welding wire, argon gas at 40 cfh and a 240-ipm wire feed speed at 240 amp were used by Pabrico for this work.

Technical representative, Air Reduction Sales Co.

MANUAL application can be made with same Mig welder used on machine. Cord is 10 ft long.

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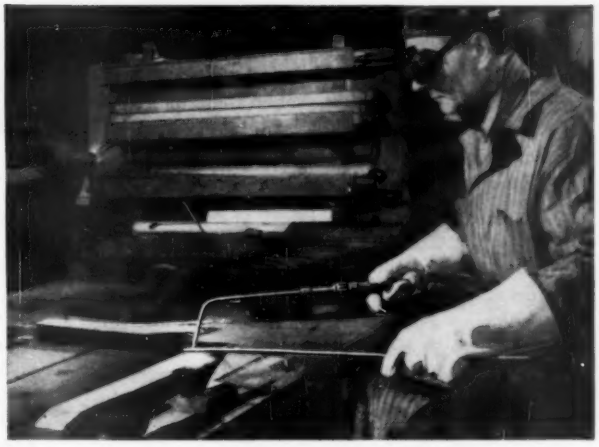

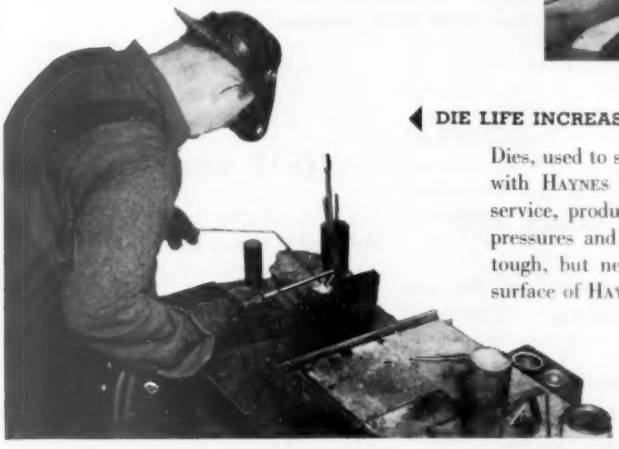

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These firms have helped

Down through the years, there have been men with ideas, with confidence in these ideas, and with faith in the development of the welding industry which would use their ideas. When these men began to translate their ideas into demands for products and services—when they stepped out to sell—they called on WELDING ENGINEER to help them.

It took time for these pioneers to gain the acceptance they enjoy today. They know it will take continued effort to maintain their present industry position and *increased* effort to better that position.

WELDING ENGINEER owes a lot to those who deemed it wise to use the pages of this magazine to build product sales and and service many years ago.

For the steadily increasing number of newcomers, it will take time and persistence to get them where they want to be tomorrow. As an aid in making sales to the growing generation, and in meeting new men and new situations, WELDING ENGINEER will continue to bring into sharp focus the primary buying power of the welding industry.

The test of time is a rugged one. Business friendships endure over 40 years only because there is a continuing exchange of valued service. We would be remiss on this, our 40th anniversary, if we did not express our appreciation of those who have given us an opportunity to prove that an advertisement in WELDING ENGINEER can be a most valuable sales asset.

We salute today's leaders in the welding industry. They planted their roots long ago by advertising in WELDING ENGINEER. Here is a list that tells, within ten year periods, when our present advertisers began their program.

40 years ago

Air Reduction Sales Co.
General Electric Co.
Harris Calorific Co.
Linde Air Products Co.
Metal & Thermit Corp.
National Cylinder Gas Co.
Westinghouse Electric Corp.

30-39 years ago

American Brass Co.
Anti-Borax Compound Co.
Burdett Oxgen Co.
Chicago Eye Shield Co.
Fibre-Metal Products Co.
Lincoln Electric Co.
P. R. Mallory & Co., Inc.
Modern Engineering
Page Steel & Wire Div.
Reid-Avery Co.
Shawinigan Carbide
Shoot-A-Lite Corp.
Smith Welding Equipment Co.
Steel Sales Co.
Stoody Co.
Weldit, Inc.

20-29 years ago

American Manganese Steel Div.
American Optical Co.
Arcos Corp.
Bridgeport Brass Co.
Duro Engineering Co.
Eisler Engineering Co., Inc.
Federal Machine & Welder Co.
Handy & Harman
Harnischfeger Corp.
Harrisburg Steel Corp.
Haynes Stellite Co.
Hobart Bros. Co.
International Nickel Co., Inc.
Metal Bond Mfg. Co.
National Carbide Co.
Sellstrom Mfg. Co.
Stulz-Sickles Co.
Taylor-Winfield Corp.
Titan Metal Mfg. Co.
Tube Turns, Inc.
Victor Equipment Co.
Welding Engineering Co.

10-19 years ago

Adjustable Clamp Co.
Aljay Mfg. Co.
Alloy Rods Co.
Aluminum Corp. of America
American Platinum Works
America Solder & Flux Co.
Ampco Metal, Inc.
Aronson Machine Co.
Atlas Welding Accessories Co.
Becker Bros. Carbon Co.
Belden Mfg. Co.
Bentley Weldery Inc.
Bernard Welding Equipment Co.
Champion Rivet Co.
Chicago Boiler Co.
Chicago Hardware Foundry Co.
Chicago Mfg. & Distributing Co.
Dockson Corp.
Eastman Kodak Co.
Eisler Engineering Co.
Eutectic Welding Alloys Co., Inc.
Flint Products Co.
Flood Safety Products Co.
Foote Mineral Co.
G. C. Fuller Mfg. Co.

Throughout its 40 years of

Welding Engineer grow

10-19 years ago

(Continued)

Glenn Co.
Hoeganaes Sponge Iron Corp.
Independent Engineering Co.
Jackson Products
Krembs & Co.
Liquid Carbonic Corp.
Machinery & Welder Corp.
Mid-States Welder Mfg. Co.
Miller Electric Mfg. Co.
Mine Safety Appliances Co.
Modern Engineering Co.
Mueller Electric Co.
National Welding Equipment Co.
Norton Co.
Progressive Welder Sales Co.
Rankin Mfg. Co.
Ruemelin Mfg. Co.
Sight Feed Generator Co.
A. O. Smith Corp.
S-M-S Corp.
Square D Co.
Titanium Alloy Mfg. Co.
Tweco Products Co.
U. S. Steel Corp.
Welding Alloys Mfg. Co.
Welding Sales & Engineering Co.
Worthington Corp.
York Engineering Co.

Less than 10 years and now

Acorn Iron & Supply Co.
Anchor Metal Co., Inc.
Fred C. Archer Co., Inc.
Arcair Co.
Airline Welding & Engineering Co.
L. B. Allen Co.
Allied Steel & Tractor
Alloy Ring Service, Inc.
All-State Welding Alloys Co.
Amperex Electronic Corp.
Armor-Tuf Sales Corp.
Aro Spot Welders
Automatic Welding Co. (Wis.)
Automatic Welding Co. (Okla.)
Buck Mfg. Co.
Cam-Lok Div.
Carborundum Co.
Cayuga Machine & Fabricating Co.
Carol Cable Div.
L. H. Chappel & Co.
Colonial Abrasive Products
Columbia Electric Mfg. Co.
Contour Marker Corp.
Coyne Cylinder Co.
Crobalt, Inc.
Crucible Steel Co.
Detroit Testing Machine Co.
Diamonite Products Div.
W. C. Dillon & Co., Inc.
Doughty Laboratories, Inc.
Drawalloy Corp.
Engwald Corp.
Erico Products, Inc.
W. G. Feik Marine Products
Goldsmith Bros.
Grand Specialties Co.
Gulf Steel & Wire Co.
H & M Pipe Beveling Machine Co.
Heath Engineering
Hewitt Robins Inc.
Hossfeld Mfg. Co.
Industriline Inc.
Interstate Sales Co.
Interstate Machine Co.
Invincible Vacuum Cleaner
Kasson Die & Motor Corp.
Kedman Co.
K-G Equipment Co.
R. E. Lee & Associates
Lindberg Engineering Co.
Milwaukee Brush Mfg. Co.
Minnesota Mining & Mfg. Co.
Morton Mfg. Co.
Norris-Thermador Corp.
North American Philips Co.
Northwest Chemical Co.
Oxo Equipment Co.
Pandjiris Weldment Co.
Pure Carbonic Co.
Phoenix Products Co.
Shieldalloy Corp.
G. W. Smith & Sons, Inc.
Stahl Equipment Co.
Superior Air Products Co.
Sylvania Electric Products
Tec Torch Co., Inc.
Tempil Corp.
John Tillman Co.
Torit Mfg. Co.
Uniflex Cable Div.
Unique Turn Table Corp.
United Specialty Corp.
United Wire & Supply Co.
Unitek Corp.
Van Vooren Products
Vickers Electric Div.
Vogel Tool & Die Corp.
Wagner Mfg. Co.
H. J. Wagner Products, Inc.
Weltronic Co.

Welding Engineer

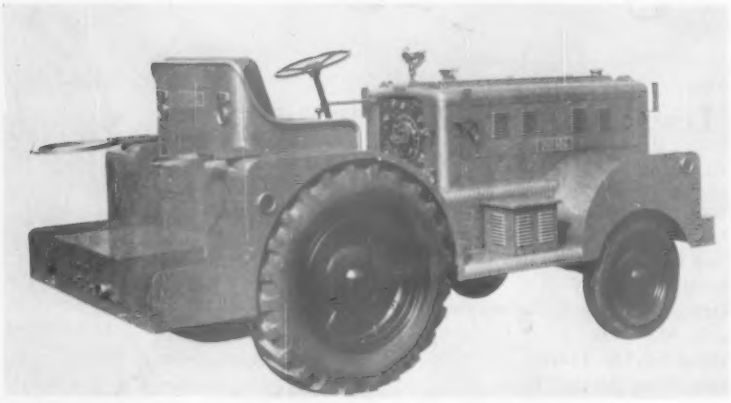
A MAGAZINE OF JOINING AND SEVERING OF METALS

P. O. Box 128, White Plains, N. Y.
Telephone: WHite Plains 9-3876

12 E. Grand Ave., Chicago 11, Ill.
Telephone: DElaware 7-0339

welding industry leadership

new products . . . . . USE CARD ON PAGE 125



MOBILE welding unit is self-propelled. It can travel directly to widely separated jobs and is ready to weld instantly.

LIGHTWEIGHT X-ray unit is for spot-check radiographic inspection of welds.

Mobile welder

WELDING unit is self-contained and self-propelled. Engine of "Weldmobile" is directly coupled to generator. Newly-designed model has large wheels in rear with gripper tires and implement type tires in front.

Welder is designed as mobile unit for widely separated jobs. Towing capacity is rated at 2,000 lb draw-bar pull. Available in 400-amp and 600-amp models. *Hobart Bros. Co.*

Circle No. 1.

* * *

Electrode

HIGH carbon electrode is for either manual or automatic application. The electrode for manual use has a brown coating and is composed of high carbon wire. It is said to deposit a carbon ratio of 0.60 to 0.70. It is suited for build up work.

An electrode without a coating is also available for manual use. It can be used for either electric or acetylene build up. *Pacific Welding Alloy Mfg. Co.*

Circle No. 2.

* * *

Shielding gas

NEW shielding gas can be used for Tig (tungsten inert-gas) welding of stainless steel, Monel, Inconel, and other metals. Termed "H-15 Argon Mixture," it is said to give good weld quality and high welding speeds.

It also is claimed to allow substantially reduced flow rates necessary for adequate shielding to the weld zone. Developed as a substitute for helium, currently in short supply, this new mixture, which contains hydrogen, is recommended to replace helium in many high-speed, high-voltage applications. *Linde Air Products Co.*

Circle No. 3.

* * *

Polishing wheel

"PG" polishing and grinding wheel is for polishing all types of metal. It consists of hundreds of pieces of cloth-coated abrasives factory-formed into a wheel that can be used on rotary or straight line automatics, or on standard lathes for hand operations.

Wheel removes stock as part of its polishing action. It comes in 20 sizes. Wheel is currently made in two types of mineral coatings—aluminum oxide and silicon carbide. *Minnesota Mining & Mfg. Co.*

Circle No. 4.

* * *

Silver solder

TWO special silver alloys are for joining dissimilar ferrous and non-ferrous metals. Melt and flow points are in the medium temperature range, falling between soft solders and low-temperature brazing alloys. Both are compounded for use with heating methods generally applicable in soldering.

One, "No. 105," is a medium temperature solder. It melts at 675 F and flows freely at 750 F, states manufacturer. The other, "No. 107," is a general-purpose silver solder for aluminum and other metals. It melts at 450 F and flows freely at 600 F, it is said. Each requires a special flux. Flux residue should be washed off with warm water. *All-State Welding Alloys Co., Inc.*

Circle No. 5.

Inspection unit

PORTABLE X-ray unit is for spot-check inspection of welds. The "Baltospot" weighs 46 lb and provides a power penetration of 140 kvp.

"Baltospot" radiographs up to 1½-in. steel. It can be used as an alternative to sectioning methods of inspection. Entire unit, composed of X-ray head and control panel, fits inside a trunk 32 by 16 by 13½ in. Two other models, one rated at 180 kvp and one rated at 260 kvp, are available. *Balteau Electric Corp.*

Circle No. 6.

* * *

Electrode

HARDFACING electrode is of the iron-powder, low-hydrogen type. "Hardalloy 48" electrode is claimed to combine speed of contact-type electrode with weld metal soundness and crack resistance of low-hydrogen weld deposits. Weld metal deposited is highly alloyed high-chromium-iron and has an as-deposited hardness in excess of 55 Rockwell C, states manufacturer.

Quick deposition rate is said to reduce welding time. Problems normally associated with base metal dilution are virtually eliminated and penetration of hard overlay material is held at absolute minimum, it is claimed. Electrode may be used with d-c reverse polarity or a-c. Designed primarily for downhand welding, it may be used in vertical position. Available in ⅛, 5/32 and 3/16-in. diameters. Electrodes packaged in moisture-proof vacuum-tight metal containers. *The McKay Co.*

Circle No. 7.

DO A MILLION DIFFERENT JOBS BETTER

• *EASIER* • *FASTER*
• *MORE ECONOMICALLY*

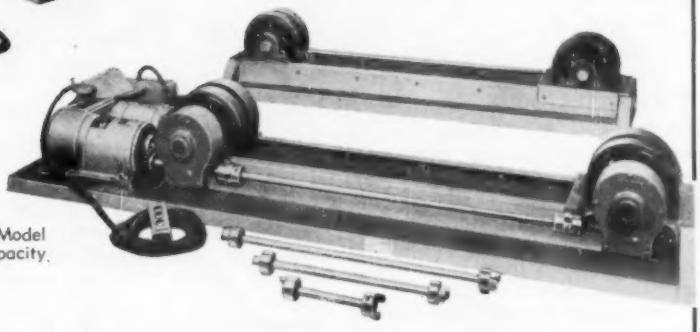
with

UNIQUE
POSITIONING EQUIPMENT

Positioner Model UPC-140
14,000 lb. capacity

UNIQUE POSITIONERS

- NO BACKLASH when **NEW**—none when **OLD!**
- Perfectly SMOOTH Rotation
- A NATURAL for INTRICATE Welding
- Designed for MAXIMUM SAFETY and OVERLOAD Protection Capacities from 500 lbs. to 60,000 lbs.



Powered Turning Roll Model
UTR-10T, 20,000 lb. capacity.

UNIQUE TURNING ROLLS

- Basic Equipment for MODERN tank manufacturing.
- PERFECT ROTATION for manual of automatic welding.
- CHOOSE from the LARGEST VARIETY of turning rolls ever offered.
- We build equipment to fit ANY AND ALL APPLICATIONS. Capacities from 1500 lbs. to 100 tons.

Write for Catalog 54C

For A Perfect Weld Every Time — In Less Time — Use UNIQUE Positioning Equipment

UNIQUE TURN TABLE & EQUIPMENT CORPORATION
122 Sumpter Street Brooklyn 33, N. Y.

Weldor's goggles

PLASTIC goggles are lightweight, weighing only 1 oz. Extremely hard-surface acetate lenses offer greater resistance to abrasion, sparks, flying chips and spatter, it is claimed. Suitable for wearing over prescription glasses, goggles fit as ordinary eyeglasses.

One-piece lens offers full vision, measures 0.050 in. thickness. Plastic frame has smooth contour-molded nosepiece and brow rest. Temples are made of flexible plastic-covered cables. Lens is available in clear or medium green. *General Scientific Equipment Co.*

Circle No. 8.

* * *

Flaw detector

DETECTOR is for locating flaws in welds, castings, laminar metals and plastics. Termed "Ultrasonic Void Detector," it consists of an ultrasonic, frequency-modulated transmitter and receiver. A sonic sound beam is transmitted through a piece under test in a tank of oil or water.

An alarm buzzer automatically sounds when a void is found. Indicating meter provides a visual percentage reading. *Sunshine Scientific Instrument.*

Circle No. 9.

* * *

Selenium rectifier

SMALL compact selenium rectifier, Type 60-9150," is a voltage doubler stack. It can be used as a doubler, and two units can be connected as a single-phase, full-wave bridge. The latter will deliver 180 volts d-c at 0.10 amp for an rms voltage input of 230 volts.

Rectifier is 21/32 by 1 1/16 by 1¼ in. overall volume. It can be mounted with a No. 8 (0.164 in.) machine screw through the hollow brass eyelet. *International Rectifier Corp.*

Circle No. 10.

Steam gun

SUITED for a variety of cleaning applications, "Hurriclean" steam gun is designed for efficiency, cool handling and easy operation, states manufacturer.

Steam passes through an insulated interior tube, solution through an exterior tube. A sealed rotary joint allows rotation of nozzle, without twisting or wrestling with heavy solution or steam hose. Forward gun end revolves for cleaning angle; handle and hose connections are stationary.

Gun has cast aluminum spade-type rear handle, cast brass valves, stainless steel outer and inner tubes and nozzle and oil-resistant forward rubber grip. It weighs 6/34 lb in its 3½-ft length. Rinsing is done by using steam-alone. *Oakite Products, Inc.*

Circle No. 11.

* * *

Pipe support

PRINCIPALLY designed to support piping and equipment subject to vertical movement, "Bergen Vertical Constant Support Model CSV," is a single-spring device. It yields a constant supporting force at all positions throughout its entire travel range, states manufacturer.

Housing of unit forms its structural frame. It may be welded or bolted directly to the supporting structure when headroom is particularly limited. "Model CSV" is adaptable to all loads and travels. Friction is minimized by bearings at all main rotating points. Piping position is indicated by pointer permitting reading from a considerable distance. Moving parts are permanently lubricated. All units provided with small amount of overtravel beyond rated total travel of unit. *Bergen Pipesupport Corp.*

Circle No. 12.

For more information use card on page 125

Grinding wheel

GRIT-cloth wheel is now available in 10 and 12-in. diameters for mounting on buffing lathes and heavier polishing and deburring operations. In coarse grit grades, "Grind-O-Flex" wheel is capable of fairly heavy flash removal; in fine grits, it polishes contoured pieces to a plating finish.

The grit is embedded in the cloth. Wheel never needs regritting and the "scratch" is uniform for life of wheel, states manufacturer. *Merit Products, Inc.*

Circle No. 13.

* * *

Build-up electrode

DESIGNED especially for maintenance and repair welding, "Jet-Hard BU-90" is an iron-powder electrode for fast build-up of worn parts. It produces a medium-carbon, medium-alloy deposit, giving a dense, moderately hard, tough machinable surface.

Arc is smooth with minimum spatter. Electrode deposits chromium and manganese to increase impact resistance and toughness. Hardness range runs from 27 to 40 Rockwell C under normal welding conditions. Hardness can be increased by water-quenching the deposit from 1,600 F. Can be used on either a-c or d-c straight polarity; available in 5/32, 3/16 and ¼-in. sizes. *The Lincoln Electric Co.*

Circle No. 14.

* * *

Dust collector

UNIT for dust control is said to remove microscopic solids, fumes and odors from exhaust gases. The unit, known as "Type A Hydro Precipitator Scrubber," collects dust by hydrocompressing exhaust gases through a system of multiple tubes into a water chamber.

Scrubber is available in 15 sizes, for capacities ranging from 500 cfm to 40,000 cfm. Each scrubber has inspection doors and water-tight inspection window in the tube chamber. *The Johnson-March Corp.*

Circle No. 15.

P&H Welding Positioner

Doubled Production

— free report shows how

A P&H positioner can cut your welding costs up to 60%, because it reduces waste-motion and fatigue. It is the only positioner available with a safe tilting range of 135 degrees. A pushbutton quickly and easily rotates, tilts, or moves the piece vertically to provide economical downhand welding.

Because welders are always working in a downhand position, they can deposit metal up to twice as fast.

Read about the money-saving, production-boosting features in the complete impartial report offered here. Just mail the coupon.

HARNISCHFEGER
MILWAUKEE 46, WISCONSIN

I'M SMOOTHARC SCOTTY...
with a certified, impartial report that shows how P&H positioners doubled production. It's free...and it may help you save money on your welding operations. Just send for it.

SEND COUPON TODAY FOR FREE REPORT!

3104

P&H HARNISCHFEGER CORPORATION
4513 W. National Ave., Milwaukee 46, Wis.
Attention: W. R. Stephens, Sales Manager

I am interested in Report No. W-5408.
Please send my copy.

Name ..... Title .....

Company .....

Company Address .....

City ..... Zone ..... State .....

the P&H *Line*

P&H welding equipment is manufactured and sold in Canada by REGENT EQUIPMENT MANUFACTURING COMPANY LTD., 455 King Street West • Toronto, Ontario, Canada

BERNARD

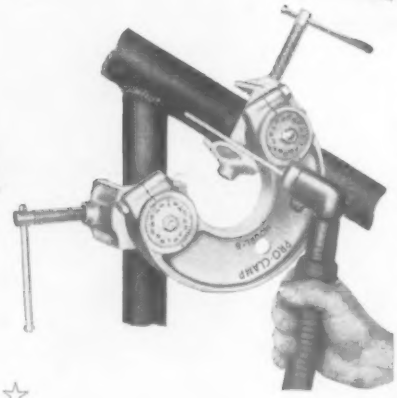
(PIONEER FOR MODERN WELDING)

"Shortstub" ELECTRODE HOLDER

The jaws substitute for stub waste by splicing a 2 inch extension to the length of every electrode.

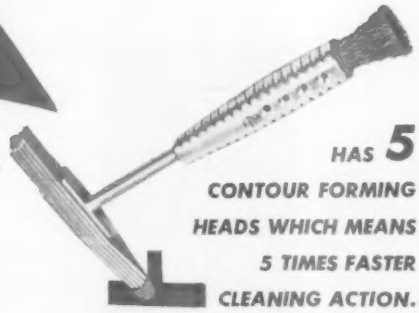
"Pro-Clamp" MECHANICAL HANDS

MODERNIZE the fabrication of plates, shapes, rods, bars, pipes, etc. MAKE fitting, positioning, holding, and welding a fast, accurate, inexpensive, one-man job.



"Multi-Pic" CONTOUR CLEANER

Delivers FIVE surface cleaning blows with each swing and lasts FIVE times longer than single headed hammers.



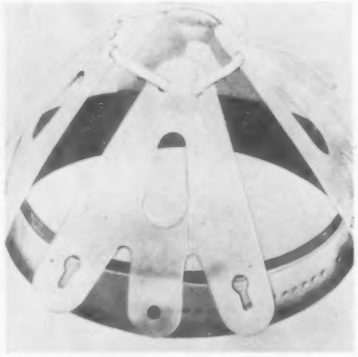
HAS 5 CONTOUR FORMING HEADS WHICH MEANS 5 TIMES FASTER CLEANING ACTION.

See Your Local Dealer, or, Write for Bulletins, SS-3, MP-6 and PCB-6

Manufactured By

BERNARD WELDING EQUIPMENT CO.

10232 AVENUE N, CHICAGO 17, ILLINOIS



Safety hat

SAFETY hat is molded from flame-retardant waterproof material. Termed "Supergard," hat has full-floating adjustable headband. Hat also has wrinkle-free sweatband, leather and leatherette. Unique plastic cradle supports hat when on the head. *The Boyer-Campbell Co.*

Circle No. 16.

* * *

Dust collectors

ALL of this firm's dust collectors—both the cabinet and cyclone types—are now available with casters as optional equipment. Although these units can now be moved around, the addition of casters will make such movements quicker, easier and more quietly, manufacturer states.

Seventeen affected. *Torit Mfg. Co.*

Circle No. 17.

* * *

Clamp

TWO new heavy-duty "Titan" toggle clamps are for rugged jobs requiring vise-like holding pressures. Both models have replaceable parts, forged alloy-steel components and holding pressures up to 4,000 lb.

Each weighs 4½ lb. Model "557" is for situations where overhead clearance is limited. Model "558" is recommended for jobs where clearance allows use of an upright handle. *Detroit Stamping Co.*

Circle No. 18.

* * *

Flaw detecter

"MODEL LR" is a compact ultraviolet radiation generator of the pencil-type, capable of performing analytical and inspection work. Detection of flaws and cracks is accomplished by immersing the specimen in a solution, such as anthracene, and testing under ultra-violet light after washing off the excess. Fissures deeper than superficial cracks, continuity of welds and porosity of sintered parts are clearly revealed. *Sela Electronics Co.*

Circle No. 19.

ASBESTOS–*fiber of the Ages!*

Through countless ages, when the world was in the making, asbestos, the wonder mineral, survived unchanged. Today, it is an important filler component of Norris-Thermador Acetylene Cylinders. Springy, long-fiber asbestos of the highest quality obtainable is used to bind and strengthen the other filler components of charcoal, diatomaceous earth and cement. Light in weight, this specially-selected asbestos also contributes to the filler's gas capacity, lightness and uniformity, as well as to the cylinder's greater serviceability and safety.

Note These Further Advantages of
NORRIS-THERMADOR ACETYLENE CYLINDERS

Cold-drawn construction...light-weight for easy handling...bases curled *under* for maximum strength and compact storage...larger cap holes...tags easily read without having to remove them ...all welding x-ray controlled...specifications ICC-8 met and exceeded.

Acetylene cylinders from 10 to 300 cubic feet capacity.
Write or wire for specifications on all sizes. Cable Northerm.

NORRIS-THERMADOR CORPORATION
5215 SOUTH BOYLE AVENUE, LOS ANGELES 58, CALIFORNIA, DEPT. WE-156

3-1060

GB Silver Brazing Alloys

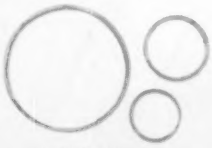
Used in Many Hospitals Where Safety Means Life or Death

Sound, leak-proof joints are a MUST in hospital construction requiring the piping of Oxygen and Anesthetic Gases to wards, rooms and nurseries *for instant use!* That's why leading designers and contractors specify dependable GB Silver Brazing Alloys, Preformed Rings and Fluxes.

GB Preformed Rings, for example, assure stronger, safer everlasting joints. They save time, require less metal, meet all specifications, cost less. Perhaps life or death are not a factor when you do silver brazing, but the dependability, efficiency and economy provided in GB products are good reasons for their choice . . . especially when they cost so little.

. . . Shown above is typical installation of oxygen wall outlet, snap coupler and flow meter. GB Preformed Rings are used to braze (1) wall assembly to screen; (2) tube to regulator; and (3) tube to gauge. For complete data write today.

GB FLUXES are fully active, deep penetrating, stable and economical. Produced under strict laboratory control they are extremely effective in producing high quality joints.



GB PREFORMED SILVER BRAZING RINGS are available in a wide range of sizes for all requirements. They are easy to use, save time and labor, assure lasting results.

GB SILVER BRAZING ALLOYS are made in random coils, strips and many special shapes in addition to preformed rings. Also available is Goldsmith's Technical Service Division cooperation for competent assistance in all brazing problems.

Dealer Distributor Inquiries Invited **Write for GB Data Book**

Goldsmith Bros. SMELTING & REFINING CO. Est. 1867

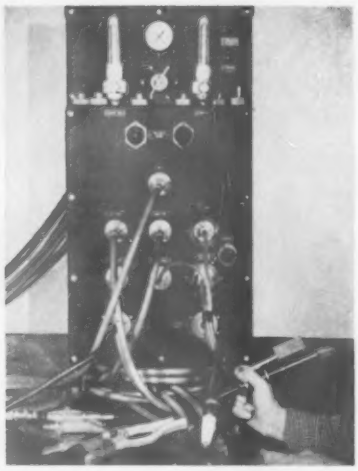
1300 W. 59th Street • Chicago 36, Ill. — *NEW YORK • DETROIT • OAKLAND*

Mail Coupon for your FREE copy of the GB Data Book — complete information on low temperature Silver Brazing

PLEASE SEND GB Data Book without obligation.

Name_____

Address_____ City_____ State_____



Welding control

ACCESSORY control unit is designed for inert-gas (helium, argon and CO_2) shielded arc welds, using conventional welding machines. This portable, high-frequency unit provides automatic control of torch and back-up gas, torch and fixture cooling water, high-frequency starting spark and welding current.

Welding current input may be from a-c or d-c motor generator, d-c rectifier, a-c transformer or gas-engine-driven machines. Control has welding current polarity indicator, back-up and torch-gas flowmeters receptacles for conventional arc welding, air pressure regulator with air supply fittings and 110-volt auxiliary power receptacles. *Flexweld Mfg. Co.*

Circle No. 20.

* * *

X-ray inspection

X-RAY unit is for rapid inspection of welds, pipelines, etc. The "MG 160-D" provides either 40 or 120-deg apertures. It is small, light and portable, designed for maximum radiation safety, states manufacturer.

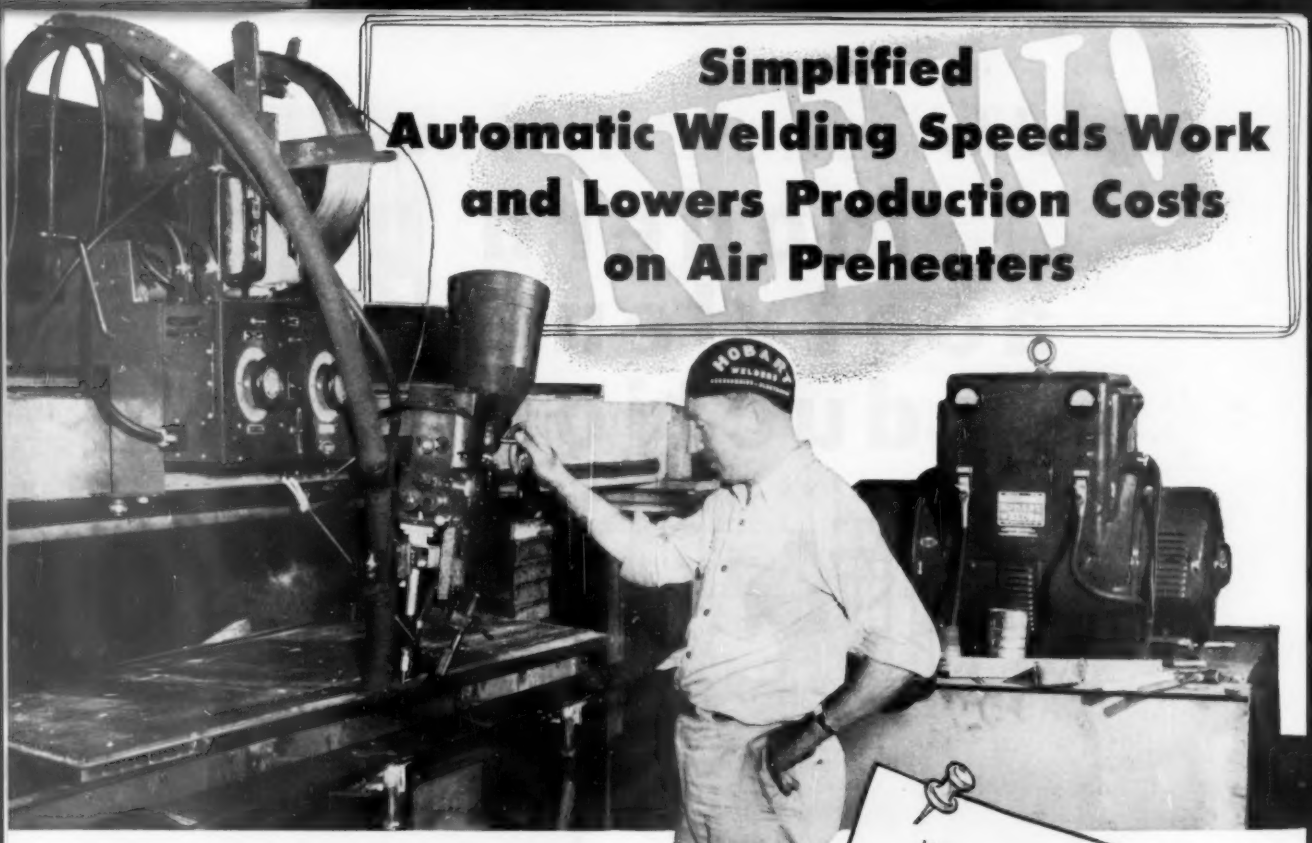
New-design tubehead has a 1.5 mm focal spot and rotatable indexing radiation diaphragm, with two apertures 180 deg apart.

The 120 deg aperture and eccentric placement of tubehead within cylindrical vessel means only two radiographs are necessary to cover entire circumference. Tubehead also contains high tension generator of 160,000-volt output. Combination tube and generator unit is 39 in. long. *North American Philips Co., Inc.*

Circle No. 21.

For more information use card on page 125

Simplified Automatic Welding Speeds Work and Lowers Production Costs on Air Preheaters



Greater savings in production costs are being realized more and more by metal working industries that are quick to see the many advantages of automatic welding.

No more complicated installations, no more troublesome electronic and electrical controls. You can depend upon Hobart's "POWROMATIC" constant voltage and new simplified controls to give you perfect welds automatically and continuously—thus reducing labor, time and material cost.

This is but one of many installations of Hobart Automatic Welding Equipment that is paying off for the user. If you have a welding operation—investigate now, and see how you can take advantage of lower production costs.

There's no cost or obligation—why not see for yourself what can be done to cut your own costs.

Write — wire — or 'phone

HOBART BROTHERS COMPANY
Box U-162, Troy, Ohio, Phone 21223

When your product is a fuel saver that cuts your customer's operating costs

YOU'RE COST CONSCIOUS

That's why The Preheater Corp., Wellsville, N. Y., one of the largest manufacturers of Air Preheaters, installed the new

HOBART

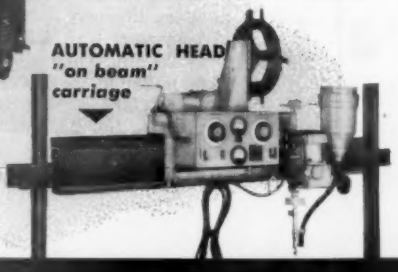
Automatic Constant Voltage Welders with "SIMPLIFIED" welding head and controls.

You can't afford to be without this valuable information **Mail Today!**

HANDOMATIC *semi-automatic submerged arc*

Hobart's "simplified" control and "Powromatic" constant voltage power source improve automatic welding results—each unit can be used with existing setups, or teamed for superior results.

AUTOMATIC HEAD *"on beam" carriage*



HOBART BROTHERS CO., Box U-162, Troy, Ohio, Ph. 21223

Without obligation, send me information on items checked below.

- ☐ Hobart CV POWROMATIC and Heads for Automatic Welding.
- ☐ Tell me how we can simplify Automatic Welding without present Heads by using Hobart POWROMATIC.
- ☐ "Handomatic" Semi-Automatic Manual inert gas.
- ☐ "Migarc" Semi-Automatic manual inert gas.
- ☐ Beam Type Travel Carriage ☐ Automatic Welding Wire

Name_____ Position_____

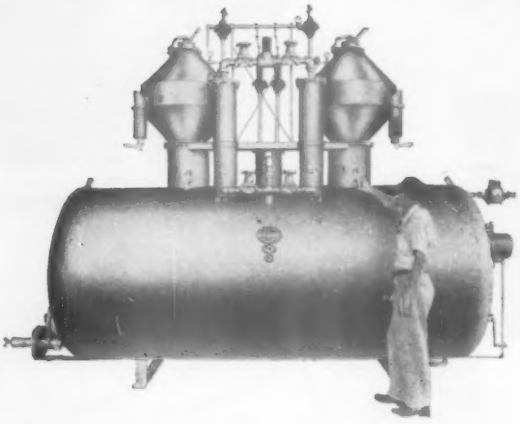
Firm_____

Address_____

☐ Send latest HOBART Simplified Arc Welder Catalog.

designed for

modern acetylene production



Sight Feed

MODEL A-TWIN GENERATOR

for pipe-line distribution

If you're modernizing present shop facilities or enlarging acetylene production, investigate the Model A-Twin Generator. When requirements demand, acetylene can be produced continuously, without necessity of shut-down during recharging. Operation is safe and virtually automatic, requiring a minimum of attention and maintenance. No tank purging... No waste of acetylene.

Your welding supply distributor will be glad to discuss the economy and convenience of the Model A-Twin with you. Ask him for literature and our print No. 210-10-A, suggesting arrangement of a Model A-Twin and pipe-line system in your plant. If unavailable locally, write or phone

THE SIGHT FEED GENERATOR CO.

55 East Third St.

WEST ALEXANDRIA, OHIO, U.S.A.

Forge

GAS-FIRED forge is for all types of forging, including sharpening of tools and heating metals for hardening, forming and shaping. It is especially adaptable for working in a closed building where smoke and excessive fumes would be dangerous.

Unit is ready to use by turning on blower switch and lighting gas. It burns natural or manufactured gas and has four gas jets in the hearth. It comes complete with an electric blower. *Champion Blower & Forge Co.*

Circle No. 22.

* * *

Low-hydrogen electrode

IMPROVED electrode "Rocket LH" can be used for welding in all positions. A low-hydrogen type, it is said to give more deposited weld metal with smooth uniform bead. Addition of powdered iron is said to improve stability of arc and minimize shorting out.

Welds are claimed to be smooth, uniform and slightly convex. Arc is smooth with a spray-type metal transfer. Electrode is available in 1/8, 5/32, 3/16, 7/32 and 1/4-in. diameter sizes. *Hobart Bros. Co.*

Circle No. 23.

* * *

Air-tool filter

FILTER, designed for air-operated tools, is lightweight, fully automatic and self-adjusting. The new "Emco L-200A Jet" weighs 12 oz, with major parts made of aluminum. Unit operates by differential of pressure. Air flowing through unit causes moisture, rust, grit, sludge and other abrasives to collect in main filter chamber.

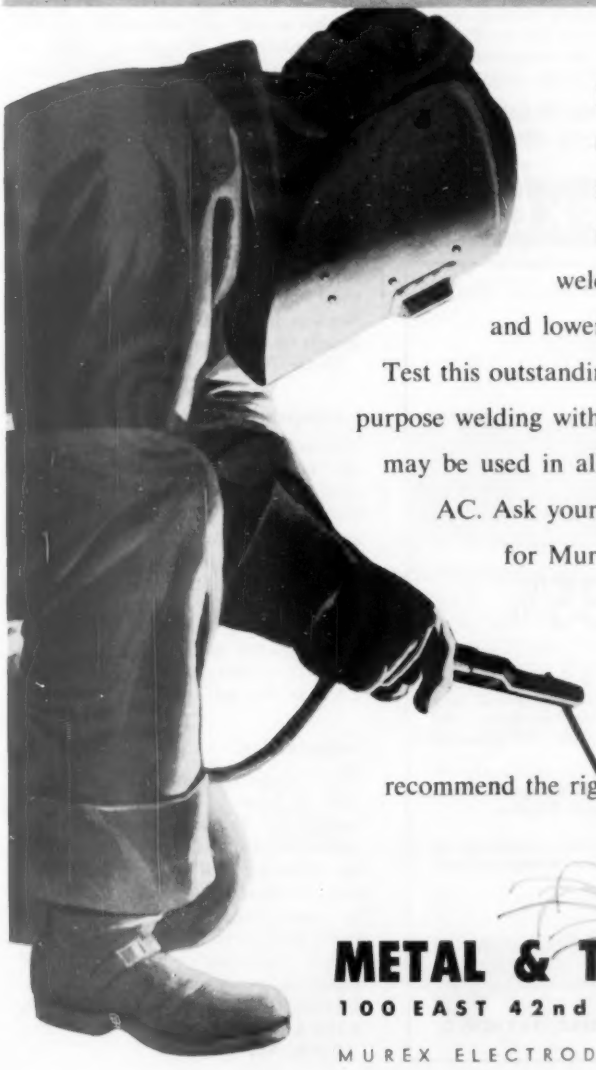
Sudden stoppage of air flow causes internal valve to change position. Foreign substances are then jettisoned through opening at bottom of separator. Unit has range of 1 cfm to 20 cfm. Operating range is from 60 to 250 lb air pressure. *Emco Pneumatic Corp.*

Circle No. 24.

15 Good Reasons Why

GENEX M can improve your E-6012 welding

SMOOTH ARC	WIDE CURRENT RANGE	GOOD ROOT BEAD CONTOUR
STEADY ARC	OUTSTANDING ON AC	PLEASING SURFACE APPEARANCE
MINIMUM SPATTER	GOOD WETTING ACTION	EASY TO USE ON VERTICAL DOWN
EASY TO RE-STRIKE	EXCELLENT FILLET CONTOUR	GOOD ON LIGHT GAUGE
NO CHANGE AS ROD IS CONSUMED	WELL-SHAPED COVER BEADS	READILY BRIDGES GAPS



Right across the board—the characteristics of all Murex Genex M qualities add up to improved welding at lower cost because they mean greater operator appeal, higher weld quality, fewer rejects, speedier welding and lower cost.

Test this outstanding electrode yourself. Designed for general purpose welding with poor fit-up on all E-6012 applications, it may be used in all positions on DC straight polarity, or on AC. Ask your nearest M&T representative or distributor for Murex Genex M electrodes—You will like the way they handle, and be amazed at the results.

There is a Murex electrode for *every* welding use. Ask your M&T man to recommend the right electrode for your next job.

METAL & THERMIT CORPORATION

100 EAST 42nd STREET • NEW YORK 17, N. Y.

MUREX ELECTRODES • ARC WELDERS • ACCESSORIES

SAVE TIME AND MONEY!

A SMOOTH SWING of the Contour Marker's soapstone point and you're ready to cut! It's easy and *absolutely accurate* because there is an angle dial calibrated in both degrees and pitch. Any of the pipe joint angles shown can be marked off in minutes. And you save "man hours" as well as oxygen and acetylene gas because "cut and try" methods are completely eliminated. Two sizes are available complete with adapter for marking structural steel. Standard, for pipes from 1½" to 18" dia.; Jumbo, for pipes from 16" to 48" dia. Instruction book included. Belt case available. Write for information

CONTOUR MARKER CORPORATION OF CALIFORNIA
1843 E. Compton Blvd., Compton, California • NEwmark 1-9474

THE CONTOUR MARKER

cut weld cleaning time by 85%

Throw away your cold chisel and whisk off weld spatter with a dry rag! Protect-O-Metal spatter-proofing compounds make weld cleaning a breeze. Improve your welds at the same time — P-O-M compounds quiet the arc, improve fusion and electrode operation, prevent oxidation and annealing scale, cause no porosity. No smoke, odors, or fumes.

P-O-M No. 2. Non-inflammable, non-toxic, water-soluble paste. Inorganic. Thin before applying and start welding at once. $3.30 per gallon, f.o.b. Dayton.

P-O-M No. 8. Rust- and corrosion-resistant resin base compound. Comes ready to use. Safe for all metals. Good paint primer; permits outdoor storage of sub-assemblies. $3.35 per gallon, f.o.b. Dayton.

MONEY-BACK TRIAL OFFER

Order a trial gallon of each today for testing in your shop. We'll cancel the bill if you're not satisfied.

PROTECT-O-METAL
G. W. SMITH & SONS, INC. 5408 KEMP ROAD, DAYTON, O.

Welding guide

ATTACHMENT for semiautomatic welders, "Portamatic Pacer," is said to provide welding accuracy and speed. It also is said to give smoother welds with minimum distortion. Guide is made of aluminum, stainless steel and brass. It is equipped with an all-sealed, d-c aluminum motor controlled by a button on the handle. Unit weighs 3½ lb.

Stainless-steel, non-magnetic, 3½-in. guide wheel speeds "Pacer" on smooth continuous bead. A second wheel may be attached to give added support. Unit has a telescoping drive shaft, adjustable to desired heights. Stepless d-c control box is built for speeds up to 80 ipm. *Carlson Mfg. Co.*
Circle No. 25.

* * *

Compressor

"STANDARDAIRE" intercooled compressor is designed for high-pressure compression of air and other gases. Unit has a pair of axial-flow blowers, arranged to work in two stages, to boost discharge pressure up to a range of 15 to 50 psig. Compressor has mechanical seals for gas; labyrinth seals for air. It is available in capacities from 100 to 4,000 cfm, ranging from 15 to 600 hp. *Read Standard*
Circle No. 26.

* * *

Generator

HIGH frequency rotating generator is said to have broken the ultrasonic barrier to full-scale manufacturing operations, including soldering, grinding, cleaning and degreasing. Generator is capable of supplying power for energizing multiple arrays of above-audible sound generating transducers. These are needed to irradiate materials and products in mass production. Generator is available in size 2-150 kw. *Acoustica Associates, Inc.*
Circle No. 27.

NEW PRODUCT BRIEFS

Pipe-cutting pantograph can handle pipe up to 42 in. OD and weighing up to 400 lb per ft, it is claimed. Cuts can be made requiring up to 20 in. of horizontal torch travel. *Vernon Tool Co., Ltd.*
Circle No. 28.

* * *

Compact, close-differential relay is designed to operate on small voltage and frequency variations. *Automatic Switch Co.*
Circle No. 29.

* * *

Ceramic metal cutting tool, made of aluminum oxide, is said to perform better than metallic tool compositions. Available only in limited quantities for research and machining studies. *Norton Co.*
Circle No. 30.

* * *

Hydraulic crane is designed to serve either as a stationary mounting or as a mobile base for on-location inspection and it permits the operator to raise or lower the X-ray head from 24 in. to 87 in. *Balteau Electric Corp.*
Circle No. 31.

* * *

Portable detector is for measurement of oxygen and combustibles in exhaust gases. Enclosed in aluminum carrying case it weighs 35 lb. *Davis Emergency Equipment Co., Inc.*
Circle No. 32.

* * *

Pneumatic chisel shank is said to eliminate shank breakage. The "SN" shank has increased shank cross-section; full power of hammer is directed to chisel cutting edge. *Delaware Tool Steel Corp.*
Circle No. 33.

* * *

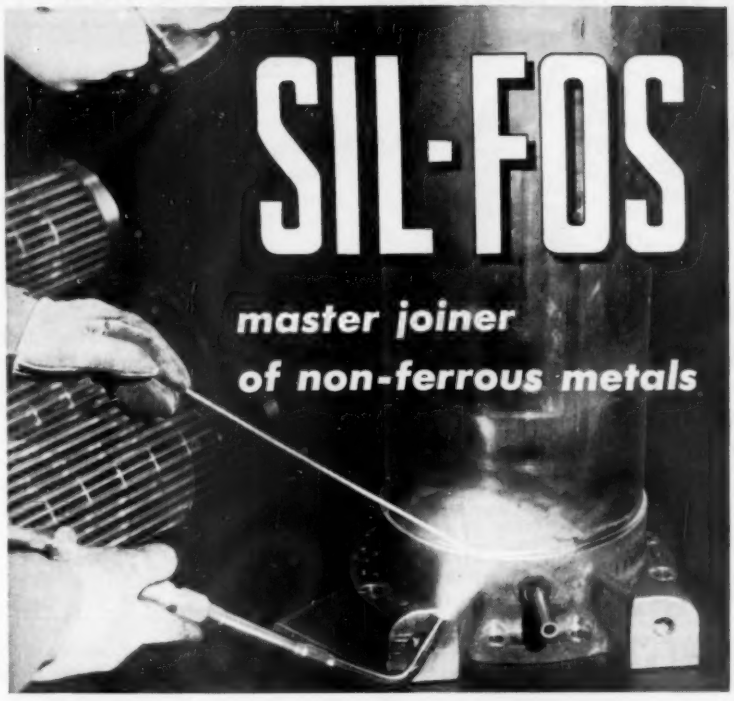
Sander can be used for roughing and finishing. Has dual action that moves in two directions at same time. Effective in grinding welds. *Detroit Surfacing Machine Co.*
Circle No. 34.

* * *

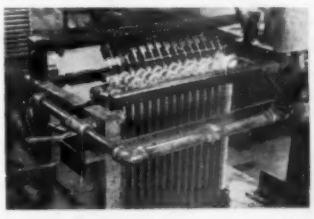
Junction power transistor, "Type 2N115 P-N-P," delivers 5 watts push-pull output with 6 volt supply. Can be used as power switch. *Amperex Electronic Corp.*
Circle No. 35.

* * *

Aluminum reel is lightweight, portable, with adjustable shoulder straps. Seven models available, for carrying varieties of cable. *Southwestern Industrial Electronics Co.*
Circle No. 36.



KEWANEE-ROSS CORP., Div. of American Radiator & Standard Sanitary Corp. use SIL-FOS in making ROSS Heat Exchangers. Here a copper shell is torch brazed into a bronze hub — 31" around — in only 5 to 6 minutes.



FEDDERS-QUIGAN CORP., use a lot of SIL-FOS 5 in assembling their FEDDERS Room Air Conditioners. Here 3 rows of return bends (40 joints) are gas-air brazed to condenser tubes at one time in less than 1 minute.

Yes, SIL-FOS has won the confidence and preference of thousands of manufacturers for joining brass, bronze, copper etc. because this low-temperature silver brazing alloy consistently makes joints *as strong as the parent metals — at surprising speed and low cost.*

The silver content does it — just enough silver to give SIL-FOS and SIL-FOS brazed joints these vital advantages:

LOW FLOW POINT — that cuts down heating time, labor and cost.

EXCEPTIONAL FLUIDITY — that assures instantaneous and complete penetration over the entire joint area for maximum strength, plus liquid and gas-tightness.

AMPLE DUCTILITY — to withstand all stresses and strains of vibration, shock and temperature changes the parent metals themselves will take.

HIGH CONDUCTIVITY — of electricity and heat.

HIGH RESISTANCE — to corrosion.

BULLETIN 20 may mean a lot of $ $ $ $ for YOU

It gives the SIL-FOS story in full. Write for a copy today.

Full technical and practical assistance is always available to users and prospective users of SIL-FOS without obligation.

HANDY & HARMAN

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BRIDGEPORT, CONN.
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TORONTO, CANADA
MONTREAL, CANADA

ALJAY "Saf-T"

APRONS · BIBS
CAPES · CHAPS
COATS · GLOVES
PANTS · SLEEVES
OVERALLS · SPATS
CURTAINS

WELDERS CLOTHING
for COMFORT, SAFETY, WEAR

The BEST in Welders' protection. Made of finest chrome tanned leather specially treated for heat resistance. Cut full size. Riveted at strain-points. Double stitched. High quality, soft, pliable, made for long hard service.

626 D. S.

Write for our New CATALOG LISTINGS and low price list "N"

ALJAY MFG. CO. INC.
SPECIALISTS IN WELDERS CLOTHING
1518 CALLOWHILL ST., PHILA. 30, PA.

Out of the past . . .

(Quotes from Vol. I of Welding Engineer)

The 8-hour day

ALWAYS in line with the progressive business organizations of the country, the International Oxygen Co. has announced that after the first of this year it will inaugurate the eight-hour day at its Newark, N. J., works.

January, 1916

Still a problem

WELDORS in the oxyacetylene field can materially help manufacturers of gas by returning empty cylinders promptly. The situation in the steel industry is such that gas manufacturers are finding it impossible to secure prompt delivery of new cylinders . . . and just when the difficulty will be removed is doubtful.

March, 1916

Women weldors

OXYACETYLENE welding, an industry itself in its earliest stages, is the latest work to attract female labor in England. Ever since the active service branch of the National Union of Women's Suffrage Societies was formed, it has kept to the fore a program of practical effort, and last September the first school for teaching welding to women was opened.

April, 1916

Cadavers vs. crankcases

MEDICAL schools experience no more trouble in securing the necessary cadavers, upon which students practice the gentle art of dissection, than do welding schools in securing a diversified supply of broken machines and parts, the repair of which will in time make a weldor.

There is this slight difference: should the medical student make the unimportant mistake of removing the liver instead of the appendix, no serious harm is done. The student is merely lectured for carelessness.

Should a student of welding, however, melt down an aluminum crankcase, left for repairs by some trusting owner, it's another matter. The subject's relative, so to speak, is apt to insist upon satisfaction, and he is also apt to blame it all on the welding system.

October, 1916

New Heath Ultra-Graph OXYGEN CUTTING

FOR AUTOMATIC, PRECISION METAL CUTTING

5 to 7 times faster than hand torch cutting

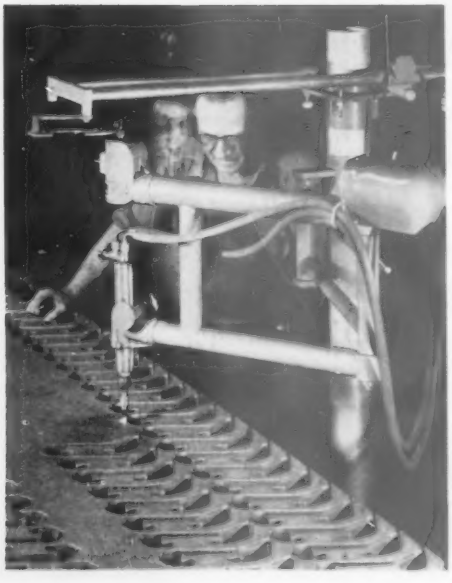
Templates made from easily cut lightweight steel; magnetic tracer arm automatically holds true tolerances for repetitive production. Duplicates intricate flat shapes, cuts holes in pipe, tubing, round bars.

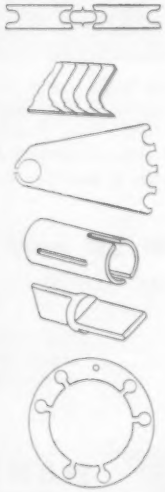
- Precision to ± 1/64th".
- Surface finishes are as smooth as 170 micron inches.
- Cuts 1/8" to 16" thick stock.*
- Cuts circles from 1/2" to 72" dia.; straight lines to 144".*

*depending on model

Ultra-Graphs Simplicity results in PRECISION and LOW COST

Sizes from $350 to $1000 fob factory





WRITE FOR NEW FOLDER

Heath ENGINEERING COMPANY
DISTRIBUTORS IN PRINCIPAL CITIES

151 AULT ROAD
FT. COLLINS, COLO.

NEWS . . . . . *from page 6*

mixed gases; stainless steel welding problems; distortion control; material selection for hardfacing; welding high temperature pressure and steam piping; automation; inspection and quality control; maintenance and repair welding; new developments.

A dinner meeting in cooperation with the Madison chapter of the American Welding Society will be held at 6:30 p.m. Feb. 23. Welding certificates will be presented to those in attendance.

* * *

Old Baltimore supply house changes hands

Ownership of what is said to be the oldest independent welding-supply house in Baltimore has changed hands.

Welders' Supply Co. was founded in 1921 by Arthur W. Carr, who has retired after 37 years in the welding equipment business (his experience ante-dates establishment of the firm).

H. Albert Fountain, former sales manager, and Paul A. Lanman are the new owners. Mr. Fountain is president; Mr. Lanman, secretary-treasurer. They will retain the old firm's name and will operate from the same headquarters at 700 McCulloh St.

* * *

Miller Electric expands facilities

Another proposed addition to the plant of Miller Electric Mfg. Co., Inc., Appleton, Wis., will add 20,000 sq ft of floor space. Present floor space of the firm is 57,560 sq ft. This site was occupied in 1946.

Miller has a history of expansion. The first addition was built in 1947. Since that time seven have been added. The proposed expansion will be the eighth.

One of the country's leading producers of arc-welding equipment, Miller Electric was founded 26 years ago. Niels Miller, founder and president, started by building welding machines in his basement. By 1932, he had built about 400 welders in such quarters.

* * *

New technique breaks the unsolderable barrier

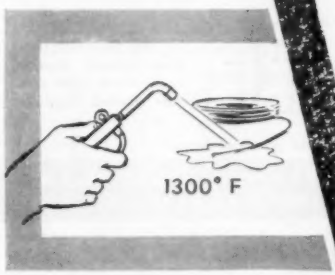
Method for joining materials thought impossible to solder has been developed at Los Alamos, N. Mex. The new technique is the work of Joseph C. McGuire of the University of California.

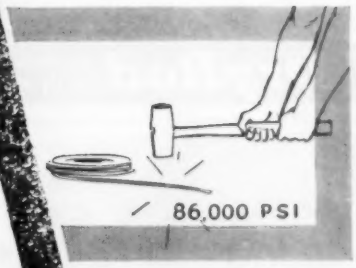
The new method requires only

Right down the line

UNITED'S PHOSON alloys

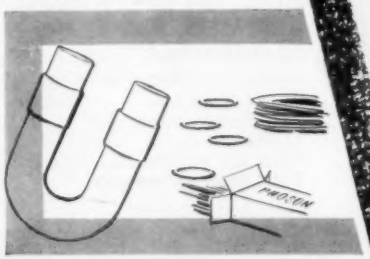
Right every time for brazing copper and brass





Here's Why:

Lowest practical brazing temperatures. There's a Phoson Alloy to meet your every requirement.



Super-Strength—Corrosion Resistant. Joints are stronger than metals brazed. Original tensile from 86,000 p.s.i. Highly resistant to most types of corrosion and generally equal to copper itself.

Join better by brazing Join best with PHOSON or SIL-BOND.

Choose Sil-Flux for every fluxing need.

High Capillary Attraction and Versatility. Provides outstanding free flow and deep penetration. Ideal for preplacement or face-fed application. Efficient in both tightly-fitted or more loosely-fitted joints. Phoson Alloys are available in straight lengths, coils or preformed rings. *Contact your United Welding Supply Distributor or write*

Permanently United

UNITED WIRE AND SUPPLY CORP.
Brazing Alloy Division
PROVIDENCE 7, R. I. • OFFICES IN PRINCIPAL CITIES

LOOK TO UNITED FOR THE BEST IN ALUMINUM, COPPER AND BRASS TUBE AND WIRE.

Stops moisture pick-up

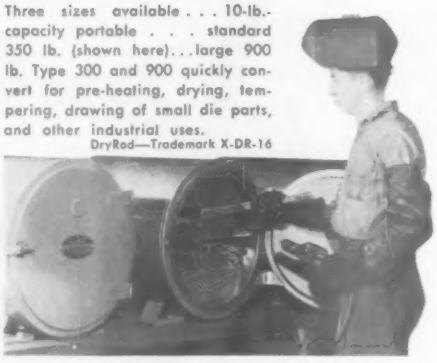
Your cheapest insurance against wasteful defective welds is DryRod. This oven protects low-hydrogen, austinetic, and other special alloy electrodes, as well as the new iron powder contact rods, against moisture.

DryRod contributes to steady welding, less slowdown, less re-work, less scrap. It can pay for itself out of rod salvage alone. Operating cost is less than 15c per 24 hours.

DryRod is completely wired, ready for use. Automatically controlled temperatures adjust from 175° to 550° F. for storage or re-baking.

Three sizes available . . . 10-lb.-capacity portable . . . standard 350 lb. (shown here) . . . large 900 lb. Type 300 and 900 quickly convert for pre-heating, drying, tempering, drawing of small die parts, and other industrial uses.

DryRod—Trademark X-DR-16



Cut costs 4 ways with DryRod Method!

1 Store sealed cartons in warm, dry place.

2 Place unpackaged electrodes in DryRod Oven and withdraw as needed.

3 Locate DryRod as close to welding operations as possible.

4 For flexible, large-volume storage, stack ovens with compact DryRod Stands.

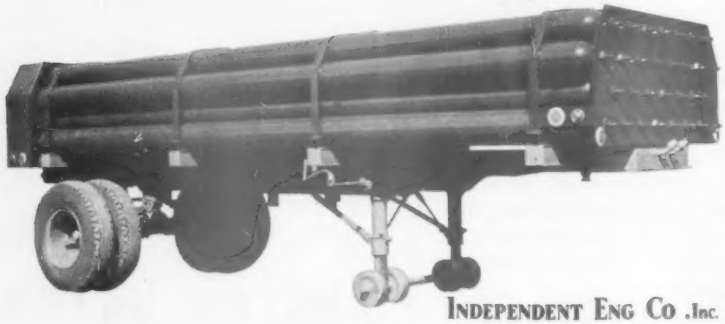
For details, see your welding supply dealer or write . . .

DryRod DIVISION OF **Phoenix Products Co.**
4715 N. 27TH ST. MILWAUKEE 16, WIS.

REDUCE CYLINDER HANDLING up to 50%

with INDEPENDENT *Gas Supply TRAILERS*

TRANSPORTING — Argon — Carbon Dioxide — Helium — Nitrogen — Oxygen — Boron Trifluroide — Hydrogen — Ethylene. Trailer capacities from 187,000 cu. in. to 750,000 cu. in. water capacity. Trailer tubes ICC3A-2400 Specifications with 2400 PSIG Working Pressure.



Sizes and weights to meet all State requirements.

Can be mounted on bases for permanent storage.

INDEPENDENT ENG CO. Inc.
CONSULTING · RESEARCH · DESIGNING
O'FALLON 5, ILLINOIS

a hand grinder with an abrasive wheel. Conventional soldering materials are utilized.

After starting the grinder, the wheel is placed on soft solder. The solder melts and flows onto the wheel. The solder-loaded wheel is then applied to the surface to be soldered until a slight amount of abrasion takes place.

Heat of friction melts the soft solder, which flows onto the freshly abrased surface and forms a contact. Preheating the abrasive wheel by grinding metal is recommended. The technique was discovered while investigating the value of ultra-high frequency sound waves in soldering.

* * *

Lincoln opens new branch

The Lincoln Electric Co., Cleveland, has opened a new branch office and warehouse in Denver at 1224 Walnut St. District Manager will be Merrill F. Yale. Johnson Supply Co. will continue to sell Lincoln Products.

* * *

Joseph Co. holds welding clinic

E. R. Joseph Co., Norristown, Pa., celebrated its 10th anniversary by holding a welding clinic. The clinic was a success, in spite of unfavorable weather.

* * *

Wilson Welding Supply in new building

Wilson Welding Supply Co., Cumberland, Md., recently moved into a new building located six miles south of Cumberland. The new plant has 1,500 sq ft of floor space.

* * *

116 at NWSA Houston meeting

One hundred and sixteen members and guests of the National Welding Supply Association attended the Southwestern Zone meeting at the Shamrock Hilton Hotel, Houston, Dec. 8 and 9.

With Association Vice-President Paul Haygood, Louisiana Welding Supply Co., Baton Rouge, in charge, the meeting opened with remarks by R. C. Fernley, secretary, and E. C. Caluwaert, president.

Robert W. Kneebone of The National Bank of Commerce, Houston, presented many interesting thoughts regarding the economic outlook and particularly the future in the Southwest. Fred W. Smith, Jr., Acetylene Welding Supply, San Antonio, led a

discussion on "Effective means of promoting a new line," which aroused considerable interest in the morning.

The highlight of the afternoon session of the first day was a panel discussion on "The future of the welding-supply distributor," and if this activity had not been called to a halt by the chairman, it would probably have continued far into the night.

The "Importance of cost reduction to the distributor" was the subject of a talk by C. S. Rutherford, of R & R Welding Supply Co., Des Moines. On Friday morning, there were three talks. Two of these, "Importance of aggressive merchandising" by James N. Alcock, Saginaw Welding Supply Co., Saginaw, Mich. and "Credit and collections" by Harold R. Jones, Texas National Bank, Houston, were of vital interest to the welding distributor and his everyday operations.

The third address was given by Walter M. Casey of Beaumont Rice Mills, Beaumont, Texas. Entitled, "Only America fears war with Russia," it developed the theme that politicians are able to perpetuate themselves and keep us on an extremely high tax scale by promoting fear of war with Russia. In his extensive world travels, Mr. Casey found that only in this country is there fear of war.

Norelco opens west coast office

Research & Control Instruments Division, North American Philips Co., Mount Vernon, N. Y., recently opened a new west coast office at 1485 Bayshore Blvd., San Francisco. Philip I. Wolf has been named manager.

* * *

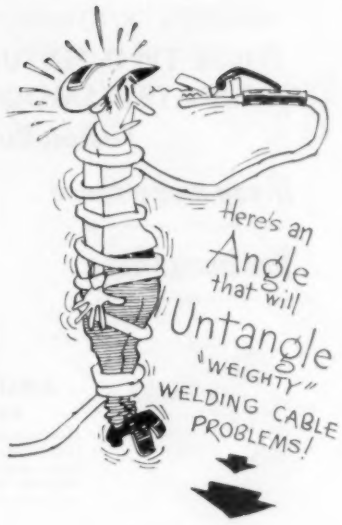
Plant Maintenance show opens in Philadelphia

The Plant Maintenance & Engineering Show is scheduled to open Jan. 23 at Convention Hall, Philadelphia. The four-day show will exhibit 278 basic types of equipment products and services. A three-day conference, held concurrently, will discuss aspects of factory upkeep.

* * *

Wayne Welding Supply holds grand opening

A formal open house and welding clinic will be held Jan. 19 and 20 to celebrate opening of new building by Wayne Welding Supply Co., Ft. Wayne, Ind. Plans included live demonstrations and prizes. Wayne Welding Supply moved into the new structure at 513-517 E. Wayne St., Ft. Wayne, Jan. 1.



***TWECO-LITE**

"the new flexible ALUMINUM welding cable that weighs half as much, lasts longer, costs less

Send for free catalog

A Product of
TWECO PRODUCTS COMPANY
Wichita 1, Kansas

A A better way to weld heavy steel plates . . .

B Because *Bux* assures perfect alignment and . . .

C Cost reductions in material and LABOR

Here is the tool that SPEEDS the welding and fabricating of heavy steel plates.

The ***Bux*** portable, magnetic plate clamp delivers perfect alignment with just the flip of a switch. No dogs or wedges. As shown in the illustrations, the ***Bux*** portable plate clamp is easily moved along the seam to be welded, holding the plates in a powerful magnetic field.

Today is the best time to find out how ***Bux*** portable magnetic plate clamps can put SAVINGS in your welding and fabricating operations. Your ***Bux*** dealer can show you how. See him, or write for fully discriptive literature to Buck Mfg. Co., 106 Roberts Road Los Gatos 5, California

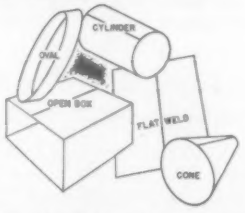
DIRECT PULL-OFF PRESSURE . . 3000 lbs.

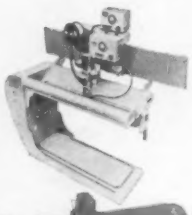
BUX portable magnetic plate clamps

AIRLINE'S "KNOW-HOW" AT YOUR DISPOSAL

THESE TWO FIXTURES CAN GIVE YOU ACCURATE – SMOOTH – PRESSURE TIGHT Fusion Butt Welds

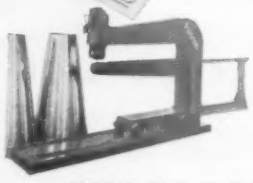
If you make these → *You need these*





AIRLINE MODEL LW SERIES 1000
Longitudinal Welding Fixture

Manufactured in 2 ft. to 12 ft. lengths. "Toe touch" control permits controlling fingers from any position. Welds sheets, cones, cylinders, boxes, etc., from .010 to one inch thickness. Suitable for MIG, TIG, submerged-arc and hand welds. Available also as complete package.



AIRLINE MODEL R 4000
Planishing Roll—60 Inch Throat

High Roller Face Pressure. Cold works welds and adjacent areas, flattens and smooths fushion welds, increases mechanical properties, reduces grinding. Also flattens flash welds, mash welds, resistance welds and elongated weld areas. Diameters 1¾ in. to 10 ft., and to 10 ft. lengths on large diameters.

WRITE TODAY FOR COMPLETE DATA AND SAMPLES

AIRLINE WELDING and ENGINEERING

785 N. PRAIRIE, HAWTHORNE, CALIF., ORegon 8-5112 - OSborne 5-2225

COYNE

ACETYLENE CYLINDERS

Symbol of Perfection

- FASTER FILLING
- HOLD MORE GAS
- EXTRA SAFE
- LIGHTER WEIGHT
- AUTOMATIC WELDS
- HIGH QUALITY
- LOW COST
- SIZES 10 TO 300 CU. FT.

WRITE FOR SPECIFICATION SHEET AND PRICE LIST

COYNE CYLINDER COMPANY

200 Paul Ave. San Francisco 24, Calif.
1155 W. Bodley Ave. Memphis 9, Tenn.

Film on cast iron available from Inco

A 15-minute, sound-color film "Ductile Cast Iron" treats the properties and applications of the metal, pointing out that it has properties similar to steel. The ductility of the iron is demonstrated by bending, twisting, impact and tensile tests. The film is available from The International Nickel Co., Inc., New York City.

* * *

Steel strip contest open for best uses

An engineers' and designers' contest for best new applications of thin-gage and/or high-precision-tolerance stainless steel strip has been announced by American Silver Co., Flushing, N. Y. First prize is $350. The contest closes midnight, May 30, 1956.

* * *

E. W. Sales opens service center

Solution of welding problems is a function of the newly-opened Midwest Service Center of E. W. Sales & Welding Service, Inc., located on Chicago's southeast side. The new center provides an extension of services of the Eutectic Welding Institute, Eutectic Welding Alloys Corp., Flushing, N. Y. Welding clinics and technical information are offered.

* * *

Welded steam pipe

—Courtesy Blaw-Knox Co.

THERE'S more to this than meets the eye. Five different heats were required to give this 30-ft section of fusion-welded chrome-moly pipe a 90-deg bend. An extremely hard, high-temperature pipe, it has a 27½ in. OD, with 1½ in. wall thickness. It will be used at a generating station for 475-lb steam reheat at temperature of 1,050 F. To insure against failure, pipe is photomicrographed after assembly has been completed.

Fabricated steel increase seen in 1956

Shipments of fabricated structural steel are expected to increase in 1956, according to the American Institute of Steel Construction, New York City. Fabricators should be able to accelerate their deliveries of customers' orders for fabricated material as steel mills increase their own output.

An estimated 2,700,000 tons of fabricated steel work were shipped by the industry in 1955—about eight per cent less than was shipped in 1954.

Favorable signs of a prosperous year ahead are (1) expansion programs now under way by steel mills, and (2) optimistic estimates of construction activity for 1956.

* * *

Liquid metal fuel is foreseen

Use of liquid metal as a fuel is believed just around the corner. A group of 14 industrial organizations, organized and administered by The Babcock & Wilcox Co., New York City, recently conducted a study of this new source of energy. The study was based on the liquid-metal fuel reactor concept (LMFR) pioneered by the AEC's Brookhaven National Laboratory, Upton, N. Y.

The LMFR system is capable of generating electric power, producing new fuel for itself, and delivering by-products to waste tanks. The fuel would be in liquid form, instead of in solid form as in most reactors. It is estimated a full-scale plant with an electrical capacity of 226,000 kw could be built and operated for a cost of 7.1 mills per kilowatt-hour.

* * *

Pandjiris offers welding help

Pandjiris Weldment Co., St. Louis, Mo., is offering a unique service to help solve problems of welding equipment users. Pandjiris, manufacturer of a variety of equipment for positioning both large and small pieces, includes machinery recommendations to its customers.

The machinery is not recommended by manufacturer's names. But, upon request, Pandjiris will recommend and set up preliminary tests on the proper type of welding equipment. The firm invites supervisory and operating personnel of firms concerned with welding to be present at such testings.

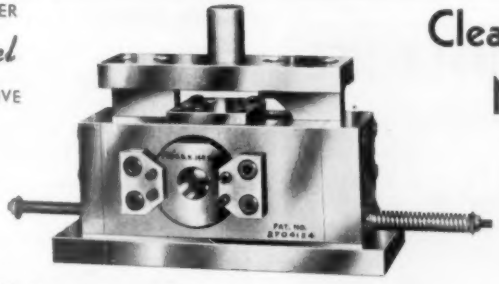
***TWECO-LITE**

*the new flexible ALUMINUM welding cable that weighs half as much, lasts longer, costs less

Send for free catalog

A Product of
TWECO PRODUCTS COMPANY
Wichita 1, Kansas

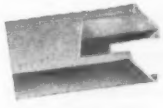
ANOTHER *Vogel* EXCLUSIVE



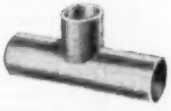
ARC TWIN-NOTCH

Clean edges . . .
No deformation . . .
Lower per-piece cost . . .

All in less than 3 seconds when you notch pipe and tubing with an ARC TWIN-NOTCH unit!



Square tube notched to fit square pipe



T-joint on tube or pipe

T-notch on end of tubular member

Shearing pipe and tube ends from the inside, the ARC TWIN-NOTCH unit leaves clean edges that require no further finishing. Automatically aligning the work, this *super fast* production tool notches both sides of 2-in. pipe or 2⅜-in. tubing with one stroke of the press ram. Work pieces are never deformed. Perfect T-joints can now be readied for welding or brazing in *less than 3 seconds.*

Special ARC TWIN-NOTCH units have high-carbon, high-chrome punches and dies for cutting stainless steel or Monel metal. Size of unit and punch shank can be tailored for individual needs. There is an ARC TWIN-NOTCH unit to fit *your* particular specifications.

WRITE FOR COMPLETE INFORMATION AND SPECIFICATIONS

VOGEL Tool and Die Corporation
1805 West 32nd Street
Melrose Park, Illinois

The ARC TWIN-NOTCH unit is offered exclusively by the manufacturers of the Standard ARC-FIT Notching Tool, the ARC-FIT Angular unit and the VOGEL Tube Cut-Off Machine.

You'll find Ruemelin Fume Collectors ideal for stopping noxious welding fumes *at their source*. Counter-balanced inlet hood stays in working area, automatically. Improves working conditions . . . lessens fatigue . . . paves the way for increased plant production. Thousands in everyday service. Write for Fume Collector Bulletin No. 37E.

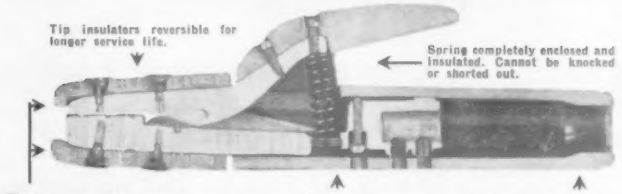
(Left) "Illustrating the 15 ft. reach collector. Handles large or small work. Units available with 15 ft., 17 ft. and 20 ft. reach."

RUEMELIN MFG. CO.

MFRS. & ENGRS. • SAND BLAST & DUST COLLECTING EQUIPMENT
3880 NORTH PALMER STREET • MILWAUKEE 12, WISCONSIN, U. S. A.

A 8409-1)-R

NOW YOU CAN SEE THE DIFFERENCE


Tip insulators reversible for longer service life.
Spring completely enclosed and insulated. Cannot be knocked or shorted out.
Slender rod gripping tongs to get into tight places.
Spring Adjustment Screw for ease of replacement and adjustment to rod size.
Handle cannot absorb moisture . . . withstands high temperature.

JUST COMPARE THESE OUTSTANDING FEATURES

Yes, now you can "see" the many important advantages in design and construction of this Electrode Holder—then make your own comparison with any other brand—regardless of price—and you'll quickly see why so many Welders, all over the country, have switched to HI-AMP. Amperage capacities range from 100 to 500.

We've shown you the "inside" of a HI-AMP—now get one in your hand and you'll "feel" the vast difference in balance and grip of this outstanding Electrode Holder. And speaking of price—you'll be surprised. That's why we say

Insist on Your Dealer Showing You A

Sold only through Welding Supply Distributors in the U. S. and Canada.

WAGNER HI-AMP

Weld with Wagner

WAGNER MFG. CO. INC., JACKSON, MISSOURI

Southeast NWSA meeting draws capacity crowd

Attendance at the recent Southeastern Zone meeting of the National Welding Supply Association established a new record. The meeting, held at the Dinkler Plaza Hotel, Atlanta, Dec. 5 and 6, drew 187 members and guests.

Chairman of the three business sessions was vice-president Leslie P. Beaver, Jr. Opening speaker was NWSA President E. C. Caluwaert on the subject, "United we stand." Other speakers included E. M. McKnight on "Effective means of promoting a new line," and Lewis F. Gordon on "The human side of selling."

A panel composed of W. R. Flannery, Harris Calorific Sales Co., Dewitt Merritt, Merritt-Holland Supply and A. C. Axtell, Essex Welding Equipment Co., Inc., discussed the future of the welding supply distributor.

Just before adjournment, the following new members of NWSA were announced: Fortson Welding Supply Co., Augusta, Ga.; Tennessee Welding Supply Co., Knoxville, Tenn.

* * *

Elliott Glove Co. builds factory

Elliott Glove Co., Inc., Oconto, Wis., has started construction of a new factory. The structure will double present manufacturing area and house glove and safety clothing production under one roof.

COMING EVENTS

JAN. 1: Fortieth Anniversary of WELDING ENGINEER.
JAN. 4-5: Job Shop Welding Conference, Iowa State College, Ames.
JAN. 23-25: Annual Meeting, Compressed Gas Association, Waldorf Astoria Hotel, New York City.
FEB. 1-2: Second Annual Midwest Welding Conference, Armour Research Foundation of Illinois Institute of Technology, Chicago.
FEB. 22-24: Welding Applications Institute, University of Wisconsin, Madison.
MARCH 12-14: Fifty-sixth Annual Convention, International Acetylene Association, Hotel Statler, Los Angeles.
MARCH 19-22: Twelfth Annual Convention, National Welding Supply Association, Hotel Roosevelt, New Orleans.
MAY 8-11: Thirty-seventh Annual Meeting, American Welding Society, Hotel Statler, Buffalo.
MAY 9-11: Fourth Annual Welding Show, Memorial Auditorium, Buffalo.

Sellstrom president visits Sweden

A recent visitor abroad, G. E. Sellstrom, president of Sellstrom Mfg. Co., Palatine, Ill., felt that Sweden was safety-minded and showed it.

"One is particularly impressed by the cleanliness of the factories," Mr. Sellstrom reported. "The aisles are clear of any obstructions and kept clean, and every effort is made for safe working conditions. Fire drills are held regularly in Swedish factories, the workers are also compelled to attend safety lectures and take training on safety and what to do in case of an emergency."

While in Sweden, Mr. Sellstrom visited several glass manufacturers. Here he watched skilled glass blowers, busily turning out famed Swedish glass. He found this process of special interest as his firm uses large quantities of glass in construction of its helmets and goggles.

Mr. Sellstrom was also impressed by the intense interest shown by Swedish industry in eye and face protection, as well as Swedish receptiveness to American-made safeguards.

* * *

New England distributors hold meeting in Boston

The New England Welding Distributors Association held a meeting recently at the Hampton Court Hotel, Boston. Officers present were: Joseph E. Martin, president; S. A. Vane, vice-president; William M. Foberg, secretary; R. C. Anderson, treasurer. The association has been in existence for two years.

* * *

Western Enterprises moves offices

Western Enterprises recently moved its sales office and warehouse to Bay Village, Ohio. Bay Village is a suburb of Cleveland. The new address is 27360 W. Oviatt Road.

* * *

Distributor appointments

Arcos Corp., Philadelphia: J. W. Fraser & Co., Charlotte, N. C.; United States Welding Works Co., Inc., Denver; Georgia Supply Co., Jacksonville, Fla.; Ferguson Welding Supply Co.; Benton Harbor, Mich.

Glendale Optical Co., Inc.: Van Dreser & Hawkins, southwestern states territory; "Corky" Anderson, for Wisconsin, Minnesota, North Dakota, South Dakota.

Harnischfeger Corp., Milwaukee: Charles W. Krieg Co., Newark, N. J.

FIRST TRULY PORTABLE
200 AMP. ARC WELDER
Weighs only 65 lbs.; carry it to the job!
WELDS 2 PIECES OF 1½ in. STEEL!

THE BREN-WELD TRADE MARK
MODEL 200 AW
Featuring the new
TRANSOIDAL
(A development of the toroidal coil)
TRANSFORMER
(Fully protected by patent applications)

Obsoletes All Other Welders of Comparable Rating!

The portable BREN/WELD does the work of conventional welders 4 to 5 times its size and weight. Eliminates the necessity to transport bulky equipment or heavy parts to be welded.

BREN/WELD handles electrodes from 3/32" through 5/32"; it has adjustable arc voltage for various arc characteristics.

BREN/WELD is ideal for plant production and maintenance, construction work, railroads, on the farm and in home workshops.

24 HOURS DELIVERY FROM STOCK!

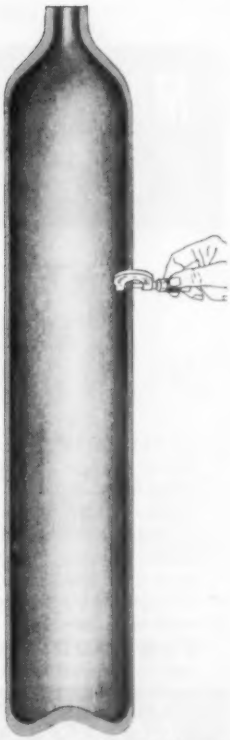
Comes complete with 2-10 ft. cables, ground clamp and electrode holder.
- 200 Amp.—At 50% Duty Cycle
- 110/220 Volts A.C., 50/60 Cycles
- Also Available For 220/440 Volts
- Simple To Use—Fully Guaranteed
- Has An 80% Power Factor.

11" x 12" x 7½"
List Price $169.50
F.O.B., L. I. City, N. Y.
Lowest Price on Market for Comparable Ampere Rating

FREE! For details of free trial offer and folder see your dealer or write directly.

A KASSON PRODUCT
Manufactured by BRENNEN, BUCCI & WEBER, INC.
SALES DIVISION
KASSON DIE & MOTOR CORPORATION
INTEGRITY SINCE 1919
32-14 Northern Boulevard, L. I. City 1, New York

How light should a gas cylinder be?



HARRISBURG Cylinders are made with an eye to the future and their ability to pass successive quinquennial tests.

They are as light as is consistent with *well-balanced design and construction.* Their most important characteristic is their unequalled uniformity of wall thickness. This unusual regularity effects an even distribution of strength throughout. There is not a weak point in a HARRISBURG Cylinder, no spot too thin or too thick.

For the sake of safety and long service life, buy HARRISBURG Gas Cylinders.

More than a century in Harrisburg
Harrisburg Steel CORPORATION
HARRISBURG PENNSYLVANIA

Due to uniformity of wall thickness there is no excess weight in a HARRISBURG Cylinder.

THE ALL NEW Weldit SINGLE STAGE Regulator

The Weldit Series 55 Single Stage Regulator is designed to meet the requirements of modern industry. It is precision built for longer life and is easily repaired without special tools.

- Top Performance
- Low Cost
- Rugged
- Dependable
- Safe
- Adaptable to both light and heavy duty work

Weldit INC. SINCE 1918

990 OAKMAN BLVD.
DETROIT 38, MICHIGAN

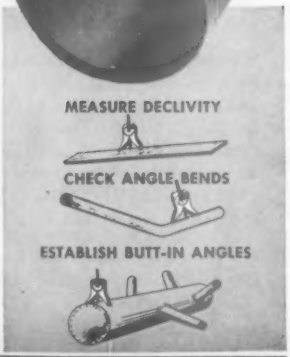
DIAL SET LEVEL _____

MARK A CENTER LINE at any angle

DIAL SET 45°

TO ESTABLISH AND MARK a point at any degree of angle on shaft, pipe or tube without numerous calculations or "cut and try" methods use the Boyce Centering Head. It's a must for welders, machinists, pipe fitters and boilermakers because it is *absolutely accurate* and saves time. Small enough to fit in your pocket, it weighs only 9 ounces. Order yours today or write for information.

CONTOUR MARKER CORP.
1843 E. Compton Boulevard, Compton, California



Boyce CENTERING HEAD

W. A. Brown, Jr., resigned Dec. 7 as president and director of The Liquid Carbonic Corp., Chicago. He will remain with the firm as a consultant. *William McCormick Blair* was elected to fill the directorship vacated by Mr. Brown.

* * *

James D. Glenn has been elected vice-president of sales and *Maurice J. Day* has been elected vice-president of research and development by the board of directors, Crucible Steel Co. of America, Pittsburgh.

* * *

George R. Milne has been appointed president of National Carbide Co., a division of Air Reduction Co., Inc., New York City. He succeeds *J. Carl Bode*, who died recently. (See obituary.) *Russell T. Lund*, vice-president, succeeds Mr. Milne as vice-president, operating. Mr. Milne will headquarter in New York City while Mr. Lund will remain at Calvert City, Ky.

Milne

* * *

H. O. Westendarp, Jr. has been appointed manager of the newly-created New York district of General Electric Co.'s welding department, York, Pa. He is a member of the American Welding Society. Mr. Westendarp has published many technical papers on welding equipment and processes. He will headquarter in Schenectady, N. Y. *Henry Keep, Jr.* has been appointed manager of the welding department's recently established New Jersey sales office and service center. Mr. Keep will headquarter at 750 Fairfield Ave., Kenilworth, N. J. He is a member of the American Welding Society.

* * *

Glenn Covington, formerly with Superior Hardfacing Co., Tulsa, has joined the sales staff of Jimmy Jones Co., Tulsa, as a sales and service engineer. His territory will be Tulsa and vicinity.

John F. Ewert, Jr. has been appointed advertising director of KSM-Products, Inc., Stud Welding Division, Merchantville, N. J. He was previously advertising and sales promotion manager, Gates Engineering Co., Wilmington, Del.

* * *

Harold Scrutton was recently named district manager of the southeast area for Hobart Bros. Co., Troy, Ohio. He will headquarter in Gastonia, N. C. *John H. Headapohl* has been named sales engineer specializing in automatic welding.

* * *

Metal & Thermit Corp., New York City, has made the following appointments to its sales force handling the new "Kel-Ray" gamma ray projector: *Charles M. Dick, Jr.*, has been named head of the sales engineer staff. He had been welding engineer at Todd Shipyards, Houston. Mr. Dick has had 19 years' experience as weldor, supervisor and engineer. He is a member of the American Welding Society and now is director of the Houston section. *Francis A. Dales* has been named sales engineer at Atlanta, Ga.; *William P. Hoppe* at San Francisco; *Harold Mears* at Pittsburgh; and *Henry C. Opie* for the Chicago area, with headquarters at the Metal & Thermit plant in East Chicago, Ind.

Dick

* * *

Lyman Pellett, superintendent of plant and production, was recently elected director by Bennett-Ireland, Inc., Norwich, N. Y. He is a member of the American Welding Society.

* * *

C. R. Van Scoy has been appointed sales engineer for southern California by Superweld Corp., North Hollywood, Calif. Prior to joining Superweld, he was owner and operator of Lafayette Metal Products, Inc.

* * *

George Fuchilla has been named foreman of the machined-ring inspection department, American Welding & Mfg. Co., Warren, Ohio.

* * *

Roy Barbier has been appointed Detroit district sales manager for Alloy Metal Wire Div., H. K. Porter Co., Inc., New York City.

Alloys and Fluxes for joining and sealing

TORCH WELDING

SOLDERING - FILLING - SEALING

TORCH BRAZING

FURNACE BRAZING

ARC WELDING

HOW TO use and apply alloys and fluxes for Soldering, Brazing and Welding Aluminum and Aluminum Alloys

WORLD'S ONE AND ONLY COMPLETE LINE of joining and sealing Alloys and Fluxes for ALUMINUM

Handiest Pocket Reference is designed Particularly to service operator needs Brief • Direct • Available on Request

This small folder is for the man at the torch or welding machine . . . will help him recognize the alloy made especially for the job he has at hand . . . will refresh his knowledge of exactly how to use it. FREE! Single copies or sufficient numbers to supply weldor crews.

All-State WRITE WIRE PHONE FOR YOUR COPY

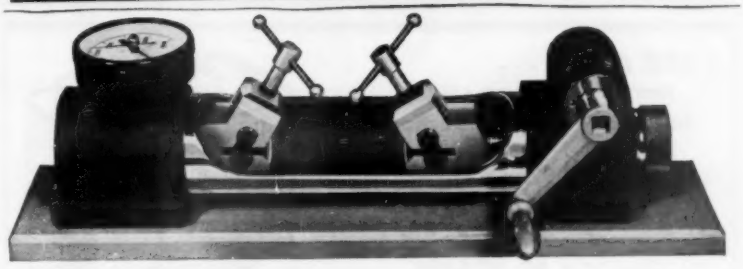
TWO NEW SOLDERS FOR JOINING ALUMINUM TO OTHER METALS

105 non-ferrous metals. **Medium Temperature Solder** Good for 18,000 psi Shear. This low cost silver solder requires no more than 750 F. for joining wide range of ferrous and

107 **General Purpose Silver Solder** Stronger—20,000 psi shear—and requiring only 600 F. Like 105, good for aluminum, copper, brass, stainless steel, etc.

Your A-S Distributor Now Stocks Both 105 and 107. Ask to see what problems they can solve for you.

ALL-STATE WELDING ALLOYS CO., INC., WHITE PLAINS, N. Y.



For shop or field—a new

Portable Tensile Tester

Use this compact, precision tensile tester to test strip steel, wire, bolts, spot welds, or anything else within its 4,000 lb. capacity. Besides its use for inspection work in the shop, this portable device provides a convincing method of demonstrating the tensile strength of various materials in sales demonstrations and trade shows.

Only a moderate pull on the crank is sufficient to apply the maximum load. Results are easily read from the load gauge. Simple to use, anywhere, any time. Write for catalog sheet and price.

DETROIT TESTING MACHINE COMPANY

9380 Grinnell Avenue, Detroit 13, Michigan

AT THE FRONTIERS OF PROGRESS YOU'LL FIND

AN AIR REDUCTION PRODUCT

FOR WELDING AND CUTTING...

IN THE RED DRUM

HIGHEST QUALITY

DUST-FREE

NATIONAL CARBIDE

Write for the name and address of the NATIONAL CARBIDE supplier nearest you.

National Carbide Company

GENERAL OFFICES: 60 EAST 42ND STREET, NEW YORK 17, N. Y.

A DIVISION OF AIR REDUCTION COMPANY, INCORPORATED

a NEW product . . .
means NEW time saving . . .
important NEW production gains!

York's

SPAT-R-PRUF COMPOUND 106

Don't sputter about spatter . . .
JUST WIPE IT OFF!

Completely eliminates grinding after welding. Just one coat, and spatter can be wiped away with a dry cloth.

Available 1 or 5 gal. cans, 5 gal. drums

- NO STIRRING OR DILUTION
- NON-TOXIC
- NON-INFLAMMABLE
- NO ODOR
- HARMLESS TO SKIN
- PERFECT PAINT BASE
- HELPS PREVENT RUST
- NO WELD POROSITY

YORK ENGINEERING CO.
3349 W. Ogden Ave., Chicago 23, Ill.

3 in 1 York's '77'
SPECIAL FLUX
FOR GENERAL BRAZING
FOR CAST IRON WELDING
FOR CAST IRON BRAZING

Norman Fleek recently joined the sales-service staff of Robt. W. Hoffman Co., Inc., Chicago. Mr. Fleek, formerly a design engineer with Robotron Corp., Detroit, will assist in expansion of Hoffman's welder and control sales-service program.

* * *

W. B. Brower has been named assistant manager of equipment sales department Air Reduction Sales Co., New York City. He succeeds *J. F. Carroll*, who has retired.

* * *

Eugene H. Kinelski has joined the Development and Research Div. of The International Nickel Co., Inc., New York City, as a research metallurgist. Mr. Kinelski will work in the Welding Section of the research laboratory at Bayonne, N. J.

* * *

Harlan L. Meredith has been appointed staff assistant at Airline Welding & Engineering, Hawthorne, Calif. He will work on welding research and process-tooling development. Mr. Meredith was formerly research welding engineer for N.A.A. Aerophysics plant, Downey, Calif. While there he helped direct development and simplification of welding, brazing, soldering of unalloyed and alloyed titanium. Mr. Meredith is chairman of the American Welding Society's aircraft and rocketry welding panel in Los Angeles and is also a West Coast AWS committeeman on welding symbols.

* * *

Died . . .

Marshall Reid, chairman of the board of The Reid-Avery Co., Inc., Baltimore, died Dec. 6 after an illness of eight weeks. He was 69. A pioneer in welding, Mr. Reid started manufacturing welding rods and electrodes in Philadelphia in the early '20s. His company did much to promote automatic welding in the early days of this process and is still one of the major producers of automatic-welding wire. Mr. Reid also was a pioneer in the aircraft industry. He built his first plane in 1911 after learning to fly under the Wright brothers. This interest, together with a hobby of

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Gloves—Garments

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BRAZILIAN DEERSKIN THE "STAY SOFT" LEATHER GLOVES AND MITTENS

TILLMAN PRODUCTS
John Tillman & Co.
Long Beach, Calif.

***TWECO-LITE**

*the new flexible ALUMINUM welding cable that weighs half as much, lasts longer, costs less

Send for free catalog

A Product of
TWECO PRODUCTS COMPANY
Wichita 1, Kansas

world travel, was maintained until his death. He is survived by his widow and two children.

* * *

Walter E. Hadley, retired operations executive of U. S. Steel Corp., died Dec. 11 at New Port Ritchey, Fla. He had served as manager of operations of the Chicago district from 1938 until 1947. Prior to that time, Mr. Hadley was general superintendent of U. S. Steel's Gary Works.

* * *

J. Carl Bode, president of National Carbide Co., a division of Air Reduction Co., Inc., New York City, died suddenly Nov. 11 at the age of 53. He was also president of the International Acetylene Association. Mr. Bode joined National Carbide in 1928 and held various posts at the Keokuk, Ia., and Louisville, Ky., plants. In 1946 he was appointed assistant operating manager; a year later he became operating manager. In 1948 he was elected president of the firm. Mr. Bode, a graduate of the University of Wisconsin, had been president of IAA since March, 1955. He had served as director for the preceding three years.

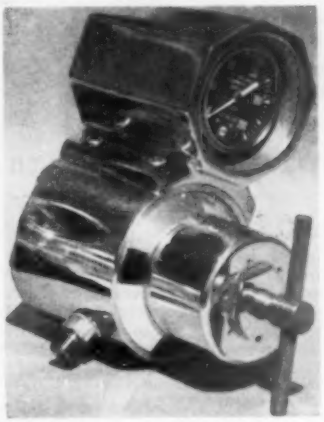
* * *

Thomas S. Wright, 52, western sales manager for the Champion Rivet Co., Cleveland, died in Chicago Dec. 9. Mr. Wright, whose association with the welding industry was lifelong, was for many years general manager of the Hollup Division of National Cylinder Gas Co. prior to joining Champion.

* * *

Lorn Campbell, Jr., president of The Harris Calorific Co., Cleveland, since 1926, died suddenly, Dec. 12. Prior to joining Harris Calorific, Mr. Campbell had been president of the United States Welding Co., Minneapolis, a company he founded in 1915 with Cyrus K. Rickel. Mr. Campbell was author of many articles that appeared in early issues of WELDING ENGINEER. He was a veteran of World War I.

Campbell



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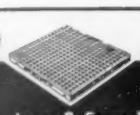
Welding  **Platens**
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51. POSITIONERS—Pandjiris Weldment Co. Catalog 8155 is a 27-page illustrated explanation of the types of positioning equipment available. Included are descriptions of turning rolls, head and tailstock positioners, gantries, seamers, welding head manipulators. Specifications for each type are given.

52. INSPECTION—Magnaflux Corp. Booklet "Lower manufacturing costs" describes ways of cutting costs through intelligent use of inspection.

53. WELDING CABLE—Kaiser Aluminum & Chemical Sales, Inc. 4-page folder describes and illustrates construction and uses of aluminum welding cable.

54. GALVANIZING—Metalloy Products Co. Illustrated sheet discusses the composition and application of "Galvalloy" galvanizing compound for bonding.

55. HAND CREAM—The Chemical Corp. Folder explains uses of "Phlo" waterless hand cream and other industrial creams, lotions and cleaners.

56. INDUCTION HEATING—Scientific Electric. 4-page folder discusses induction heaters for hardening, brazing, melting.

57. WELDOR'S WRENCHES—Master Pneumatic Tool Co., Inc. Bulletin 1040A describes air-powered impact wrenches for nut setting, tapping.

58. INDUSTRIAL X-RAY—Triplett & Barton, Inc. Bulletin "For Comparison" describes "Tri-Ind-X" portable X-ray units for industrial radiography.

59. WELDED CONSTRUCTION—The James F. Lincoln Arc Welding Foundation. "Unique design used in welded skyscraper" is a description of use of welding in a skyscraper. It is a reprint of an article from WELDING ENGINEER.

60. AUTOMATIC WELDER—Morton Mfg. Co. Bulletin No. 53 treats a variety of models of automatic welding machines.

61. CABLE REEL—United Specialty Corp. Illustrated sheet catalogs advantages of "Model EA" electric arc welding cable reel.

62. AIR CYLINDERS—The Taylor-Winfield Corp. Catalog 11-223 details "Seal-Off" air cylinders for use on welders.

63. HAND TOOLS—Kedman Co. Pocket-size pamphlet treats the "Quick Wedge" screw-holding screwdriver for use in hard-to-reach spots.

64. CLAMPS—Wetzler Clamp Co. 20-page booklet, completely illustrated, catalogs, with diagrams, specifications and photographs in use, welder's clamps and handscrews.

65. ELECTRODE—Alloy Rods Co. Data sheet describes, with specifications, 502 lime electrode for welding chrome steels.

66. SPOT WELDER—Ames Spot Welder Co., Inc. 4-page leaflet describes the portable "Ames" gun-type spot welder.

67. REPAIR — Maintenance Engineering Corp. Reprint "Mechanical Insert Repairs in the Steel Industry" is a discussion of repair welding of large castings.

68. POSITIONER — Cayuga Machine & Fabricating Co., Inc. Bulletin No. 5303 describes and illustrates "Cayuga-Matic" head and tail stocks for turning large structures and frames.

69. CABLE CONNECTOR—Cam-Lok Division, Empire Products, Inc. Bulletin 110 depicts "Cam-Lok" welding cable connectors with cut-away view of construction.

70. STUD WELDER—Graham Mfg. Corp. Bulletin G-655 describes models of resistance stud welders.

71. WELDING ROD—Eutectic Welding Alloys Corp. Bulletin TIS 2496 presents, in illustrated form, alloys, rods, electrodes for a variety of welding situations.

72. WELDER—Kasson Die & Motor Corp. 4-page folder describes 200-amp "Bren-Weld" portable arc welder.

73. BLAST CLEANING—Vacu-Blast Co., Inc. Descriptive leaflet discusses features and uses of "Vacu-Blaster" for blast cleaning.

74. WELDOR'S GLOVES—Advance Glove Mfg. Co. Illustrated sheet, in color, depicts weldor's work gloves.

75. X-RAY INSPECTION—North American Philips Co., Inc. 4-page bulletin "Norelco MG 60" gives design details and application data of lightweight portable X-ray unit for radiography.

76. HARDFACING—Mir-O-Col Alloy Co., Inc. Sheet explains application and composition of hardfacing welding rod "No. 7" for oil field use.

77. WELDING DATA—Ampco Metal, Inc. Third quarter issue of *Ampco Welding News* contains description of use of "Phos-Trode" electrodes in sheathing.

78. WELDER—Ames Industrial Welding Equipment Co. Bulletin describes eight-coil a-c arc welder with stepless current control.

79. WELDING EQUIPMENT—Smith Welding Equipment Corp. Literature describes regulators, machine type and hand cutting torches.

80. WELDING CONTROL—Weltronic Co. Technical Data Sheet No. 29 is an exposition of the kinds of welding controls for bench welders.

81. DUST COLLECTOR—Torit Mfg. Co. 4-page leaflet discusses dust collector "No. 75," with suggested applications.

82. CLAMPS—Chicago Boiler Co. Illustrated catalog describes forged-steel welding clamps.

83. RADIOGRAPHY—Metal & Thermit Corp. 4-page bulletin P-196 discusses "Kel-Ray" projector for industrial inspection with gamma rays. Bulletin tells how projector can be positioned and explains safety features of unit.

ad literature

84. Airline Welding & Engr.—Data and samples on fusion butt welds.

85. Aljay Mfg. Co., Inc.—Catalog and price list on weldors' clothing.

86. All-State Welding Alloys Co., Inc.—Pocket reference on joining aluminum and aluminum alloys.

87. Aluminum Co. of America—"Welding Alcoa Aluminum" covers every phase of welding in detail.

88. American Platinum Works—A "Complete Guide To Selective Fluxing" for low-temperature silver brazing.

89. Ampco Metal, Inc.—Literature on resistance-welding products.

90. Anti-Borax Compound Co., Inc.—Circular and sample of solder and brazing compounds and fluxes.

91. Bernard Welding Equip. Co.—Bulletins SS-3, MP-6 and PCB-6 on "Shortstub" electrode holder, "Pro-Clamp" mechanical hands and "Multi-Pic" contour cleaner.

92. Buck Mfg. Co.—Descriptive literature on "Bux" portable, magnetic plate clamps.

93. Burdett Oxygen Co.—Catalog on how "Burdox" lowers cost of welding and cutting jobs.

94. Cam-Lok, Div. of Empire Prods.—Bulletin 121 describes cable connectors and electrode holders.

95. Carol Cable Co.—Information on "Dynapower" welding cable.

96. Chicago Eye Shield Co.—Literature on welding helmets and other safety products.

97. Chicago Boiler Co.—Literature on welding clamps.

98. Contour Marker Corp.—Information on establishing and marking at any angle and laying out pipe joints.

99. Coyne Cylinder Co.—Specifications and prices on acetylene cylinders.

100. Detroit Testing Machine Co.—Catalog sheet on portable tensile tester.

101. Dockson Corp.—Catalog of welding and cutting equipment.

102. Engwald Corp.—Application data on welding-fume exhausters.

103. Erico Products, Inc.—Catalog on electrode holders.

104. Erico Products, Inc.—Information on "Caddy" test installation program.

105. Eutectic Welding Alloys Corp.—"Weldor Magazine" on increasing production.

106. Eutectic Welding Alloys Corp.—Demonstration on "Xyron 2-25," the strontium-aluminum bearing electrode and free burn-resistant welding goggles.

107. General Electric Co.—Bulletin GEA-6243 on a-c welders.

108. General Electric Co.—Bulletin GEA-6242 on rectifier welders.

109. General Electric Co.—Bulletin GEC-644 on m-g welders and Bulletin GEC-1333 on 200-amp engine-drive welder.

110. General Electric Co.—Electrode catalog GED-2584.

(Continued on page 126)

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ad literature

(Starts on page 124)

111. Glenn Co.—Literature, application data, prices on constant-potential welders.

112. Goldsmith Bros. Smelting & Refining Co.—GB Data Book giving complete information on low-temperature silver-brazing.

113. Handy & Harman—List of firm's distributors.

114. Handy & Harman—Bulletin 20 on low-temperature silver-brazing alloys.

115. Harnischfeger Corp.—Report W-5410 on low-hydrogen electrodes.

116. Harnischfeger Corp.—Report W-5408 on how welding positioners double production.

117. Harris Calorific Co.—Folder 540710 on heating torch.

118. Haynes Stellite Co.—Booklet contains descriptions and procedures for applying hardfacing alloys.

119. Heath Engineering Co.—Folder, "Automatic, Precision Metal Cutting."

120. Hobart Bros.. Co.—Information on various types of arc welders.

121. Hobart Bros. Co.—Information on "CV Powromatic" and heads for automatic welding.

122. Hobart Bros. Co.—Details on "Handomatic" and "Migarc" semiautomatic inert-gas welder.

123. Hobart Bros. Co.—Information on beam type travel carriage.

124. Hobart Bros. Co.—Details on automatic welding wire.

125. International Nickel Co., Inc.—Folder, "Repair Cast Iron Parts Quickly and Easily."

126. K-G Equipment Co., Inc—Folder on regulators.

127. Kasson Die & Motor Corp.—Free trial offer and folder on 200-amp arc welder.

128. Krembs & Co.—Chart and sample available.

129. Lewis Welding & Engr. Corp.—Details on the "Universal" automatic welding fixture.

130. Linde Air Products Co.—Booklet F-8684 describes welding and heating torch.

131. P. R. Mallory & Co., Inc.—Catalog lists resistance-welding equipment.

132. Metal Bond Mfg. Co.—Catalog on soldering and welding products.

133. Miller Electric Mfg. Co.—Data on new "SRH" and "SR" rectifier d-c welders.

134. Miller Electric Mfg. Co.—Information on welder for Tig process.

135. Miller Electric Mfg. Co.—Data on combination a-c/d-c welder.

136. Miller Electric Mfg. Co.—Information on heavy-duty industrial a-c welder.

137. National Carbide Co.—Write for name and address of nearest supplier.

138. National Cylinder Gas Co.—Literature on "Rego" regulators, torches and tips.

139. National Welding Equip. Co.—Book on regulators.

140. Norris-Thermador Corp. — Information on specifications on sizes of acetylene cylinders.

141. Page Steel & Wire Div.—Folder DH-402 sets forth analyses of automatic welding wire.

142. Pandjiris Weldment Co.—Catalog 8155 presents complete line of standard and special production welding equipment.

143. Phoenix Products Co.—Details on electrode ovens.

144. Ruemelin Mfg. Co.—Bulletin 37E on fume collectors.

145. Sellstrom Mfg. Co.—Brochure 32-G on helmets and Catalog 32 on safety equipment.

146. Sellstrom Mfg. Co.—Sample 299 fibre glass helmet on memo for test purposes.

147. Sight Feed Generator Co.—Acetylene generator facts.

148. A. O. Smith Corp.—Details on SW-15 electrodes and other welding products and services.

149. Smith Welding Equip. Corp.—Information on regulators.

150. Square D Co.—Bulletin 8991 on industrial plug-in units for better welding production.

151. Sylvania Electric Prods., Inc.—Technical information on 2% thoriated-tungsten electrodes for Tig welding.

152. Tempil Corp.—Information on, and sample pellets of, temperature indicators.

153. Tillman & Co., John—Catalog lists welding gloves and garments.

154. Titan Metal Mfg. Co.—Folder describing welding rod composition and uses.

155. Unique Turn Table & Equip. Corp.—Catalog 54C on positioning equipment.

156. United States Steel Corp.—Details on "T-1" steel.

157. United Wire & Supply Corp.—Information on "Phoson" alloys for brazing copper and brass.

158. Vickers Electric Div.—Information on d-c welder.

159. Vogel Tool & Die Corp.—Information and specifications "Arc Twin-Notch" unit.

160. Worthington Corp.—Literature on packaged positioning equipment.

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41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160

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